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AGRICULTURAL DEVELOPMENT PROJECT
COMPLETION REPORT

DEPARTMENT OF RURAL DEVELOPMENT

FEDERAL MINISTRY OF AGRICULTURE

GOMBE
AGRICULTURAL DEVELOPMENT PROJECT
COMPLETION REPORT

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SUMMARY

1. Gombe Agricultural Development Project (GADP) was intended to increase the crop production and living standards of small-scale farmers in the Gombe area of Bauchi State. It was jointly financed by the State Government, Federal Government and World Bank. It was intended to run from April 1975 to March 1980, but a series of problems delayed the start of effective operations to 1976.

2. Project costs were N22.9 million, 12 per cent below the estimate of N26.1 million. This was due to the late start-up, shortfalls in staff recruitment and infrastructure construction, and to the provision of some farm inputs at highly subsidised rates by Government. Costs for work actually achieved were generally much higher than estimated, due to severe inflation and to organisational problems within the Project.

3. A large infrastructure programme was undertaken to facilitate the development of production. Fewer reads and dams were built than original planned, due to siting and constructional problems, but those built were to a high standard. An extensive network of Farm Service Centres was constructed to distribute farm inpus and act as local extension headquarters.

4. Difficulty was found in recruiting field extension staff and the extension service was never as strong as planned. Extension agents' knowledge and training were adequate, but farmers' uptake of recommended practices was very slow. This was largely due to

lack of data on the characteristics of existing farming systems and, except late in the Project period, to lack of relevant research recommendations.

5. The Project had a major impact on farm input supply and distribution, especially in respect of fertilisers and ox-drawn tillage equipment. Uptake of other inputs was lower, and cotton spraying achieved very little acceptance, due to depressed cotton prices and lack of recommendations geared to the cropping system.

6. An Evaluation Section was established within the Project to provide information on the farming systems and the Project's impact. It suffered from under-staffing and lacked continuity in its leadership, with resulting problems of data quality. Due to data-processing problems outside the Project, data were not reported quickly enough for the major surveys to be of use during Project life.

7. Large gains in maize production were made under the Project, but the net impact on grain production was relatively small due to falling areas of sorghum and millet. Incremental production of cotton and groundnut were also negative over the Project period, cowpea being the only other crop to show gains. In value terms total incremental production was 35 per cent of that origianlly estimated.

8. Over the Project period major changes is cropping patterns took place due to the spread of ox-power cultivation, assisted by the Project's equipment sales. The final impact of these changes cannot at present be foreseen, but the form taken so far appears to be towards the development of sole-crop enterprises on a low-labour basis.

1.0 INTRODUCTION

1.1.0 Background and Objectives

1.1.1 The Gombe Agricultural Development Project (GADP) was situated in the south-eastern part of Bauchi State (formerly part of North-Eastern State) in the Federation of Nigeria. The Project was intended to increase the production of food and fibre crops and to improve the living standards of rural dwellers in the area. It was financed by the Bauchi State Government (₦8.2million), the Federal Government (₦6.7 million) and the World Bank (₦12.2 million). The Project was identified in 1972 and the World Bank loan agreement was signed on the 29th of November 1975.

1.1.2 The Project area consisted of the Gombe Local Government Area (LGA) and parts of Akko and Tangale-Waja LGA's, with a combined area of about 6,450 square kilometres, or about 8 per cent of the State. Population was estimated at appraisal[1] to be about 640,000 including Gombe township (about 50,000), but this is certainly too high. Later population estimates from evaluation studies are difficult to reconcile because of boundary changes during the Project, but studies in 1980/81 indicated a total of about 76,000 households or 470,000 people, excluding Gombe township. Population is estimated to be growing at about 2.5 per cent per year.

1/ For this and other references to the appraisal report, see "Appraisal of Gombe Agricultural Development Project, Nigeria, Report No. 367a-UNI, World Bank, Washington, September 6, 1974

1.1.3 The Gombe area has a relatively reliable rainfall of about 900mm in about 150 days, sufficient for all the crops normally grown in northern Nigeria. Soils are divided into two major types, sandy loams in the eastern part of the Project area and heavy black swelling clays ("black cotton soil") in the west. These latter soils are of high fertility but difficult to work and to build roads on. The area is one of the most intensively farmed parts of Bauchi State, at least 40 per cent being under cultivation. Traditionally sorghum has been the most important crop, with bulrush millet, groundnut and cowpea frequently grown on the same plot with it in mixed cropping Cotton is an important cash crop, but its area fluctates according to economic factors. Maize is well adapted to the environment, but was of only minor importance before the impact of the Project.

1.1.4 The Project's strategy for raising production was to attempt to raise the productivity of the small farmers (mean farm size 3 to 3.5 ha.) who form the great majority of the population and control most of the land. To this end the extension service was strengthened, supplies of farm inputs were greatly increased and a network of Farm Service Centres built to distribute them. Rural roads were improved for transport of inputs and of produce, and dams were built to improve water supplies.

1.2.0 Project Scheduling

1.2.1 GADP was intended to start operations in time for the 1975 agricultural season, but due to a number of circumstances,

including the creation of Bauchi State in 1975, the Project Manager was not appointed until August 1975 and effective operations did not begin until the 1976 agricultural season. The Project therefore effectively lost a year of its original five year scheduled life. However, during the implementation of GADP the decision was taken to extend the ADP approach to the whole Bauchi State in the Bauchi State ADP, and bridging funds were provided to maintain GADP in operation in 1980/81 pending the start-up of BSADP. GADP therefore effectively had a five year operational life, and the evaluation data presented in this report have wherever possible been updated to reflect this. Such updating also avoids the danger of distorting the balance of Project costs and benefits, since costs tend to flow more or less evenly over Project life, while benefits in crop yields and production tend to be delayed to the later years. Where comparison are made with appraisal estimates, Project Year (PY)1 is taken to be 1976/77, to allow for the delay in start-up.

2.0 FORMULATION

2.1.0 Project Identification, Preparation and Appraisal

2.1.1 GADP was prepared by a World Bank Mission in early 1973 following identification in 1972. The Project was appraised in late 1973 and the appraisal report indicated the following objectives:

- constructing about 1,000km of low cost agricultural roads, 85 earth dams, 160 tapkis (ponds), and associated soil conservation works.
- constructing an administrative centre in Gombe, 5 Development Unit centres, and 50 Farm Service Centres;

- developing and equipping seed multiplication farms at Kumo and Tumu;
- expanding training facilities at Kumo and constructing a new project training centre at Tumu;
- providing adequate farmer extension, credit and marketing services, including staff, vehicles and equipment;
- provision of seasonal and medium term loans to farmers for the purchase of crop inputs and farm equipment;
- establishing a project evaluation unit
- preparation of plans for the continued provision of project services after the investment phase of the project is completed.

3.0 IMPLEMENTATION

3.1.0 Effectiveness and Start-up

3.1.1 GADP was originally intended to become effective in August 1975. However, a number of factors combined to present this, notably the change of national leadership in July 1975 and the subdivision of North-Eastern State. These events caused numerous changes in senior Federal and State Government personnel and led to prolonged delays while new incumbents reviewed the agreements covering the Project. The full conditions for effectiveness - establishment of bank accounts, Management Unit and Executive Committee, and appointment of the Project Manager and his immediate subordinates - were not finally met until November 1976.

3.1.2. Operational start-up was delayed by problemsin recruiting a Project Manager, the post not being filled until August 1975, in the middle of what should have been the first agricultural season of implementation. Project activity in 1975/76 (PY1) was therefore confined to establishing an operational base for the Project, by securing offices and housing, recruiting staff and procuring building materials, plant, vehicles and farm inputs. One opportunity which was missed, however, was to secure early staffing and activation of the Evaluation Section so that a full evaluation survey programme could be conducted in the following agricultural season.

3.1.3 The delay in satisfying full effectiveness conditions prevented the World Bank from making disbursements under the loan during the start-up period, but in general funding was not a serious constraint. Greater problems were caused by delays and setbacks in filling senior staff positions, some of which were not finally filled until mid-1976 or early 1977.

3.2.0. Physical Implementation

3.2.1 General

GADP undertook a large buildingand infrastructure development programme both to provide its own housing and office needs and in direct furtherance of its development objectives (see Annex 1 for details). PY1 (1975/76) was devoted largely to planning and locating future developments, including dam sites, road

alignment's and Farm Service Centre locations, with priority for actual construction going to housing and FSCs. Despite the late start of the programme due to delayed Project start-up, the building programme was 70 per cent complete by the end of PY3.

.2.2 Roads

The road programme originally proposed for GADP was for 1000km of low-cost unsurfaced roads. It was appreciated in the first year of operations that the proposed standard of construction was inadequate for likely traffic flows and that such roads would be unusable in the rains, when agriculture-related traffic is heaviest. The programme was therefore revised to 500 km. of all-weather laterite-surfaced roads.

.2.3 The actual achievement was 444 km. of road aligned,cleared and formed, of which 369km, were surfaced. There was therefore substantial under-achievement even relative to the revised programme. This is attributed to a number of causes:

(a) the plant selected was not optimal, consisting largely of motor-graders which proved unequal to the task and suffered many mechanical problems.

(b) part of the programme was sited in the area of black cotton soils, which require a particularly high standard of construction and in which gravel and laterite are scarce, requiring long hauls of material;

(c) the Project had no specialist Road Engineer, the road programme being supervised by the Senior Planning Officer, and difficulties in finding and keeping a Chief Engineer further

weakened the technical direction of the programme in the first year of operations.

3.2.4 New road alignments were along watersheds to reduce erosion hazards and minimise the number of culverts required; this was achieved, less than two culverts being required per kilometre of road built. A relatively large number (87) of river crossings were constructed, about one per five kilometres of road. Large crossings were constructed of wire mesh gabions filled with rock. The final cost of the road programme was about ₦9,250 per kilometre, substantially more than estimated. This is attributed in part to the problems noted above, and also to the Project's failure to integrate the road and dam-building programmes so as to achieve better utilisation of heavy plant. However, the cost of roads was still less than half the ₦20,000 per kilometer which they would have cost if constructed by contractors.

3.2.5 Water Supply and Soil Conservation

The original programme of dam building at Gombe called for 85 earth dams with an average capacity of 100,000 cubic metres of water. To avoid damage to dam cores from drying out in the dry season it was considered that a water depth of at least 3.5 metres was required, implying a crest height of 5 metres. Catchment areas were to average 3 to 4 square kilometres.

3.2.6 It was quickly found that sites suitable for a 5 metre crest height were scarce and that where they existed they required a very long embankment. In addition the catchment areas were too large relative to the reservoirs, causing problems of spillway

erosion and accelerated silting-up. Further, the 5 metre crest height was found to be unnecessarily high, since although evaporation estimates were correct, the effective length of the dry season (defined as the period with no inflow to the reservoir) was shorter than expected. A 3.5 metre crest height was therefore considered to give adequate insurance against drying-out.

3.2.7 The programme was therefore recast on the basis of lower dams with smaller (0.6 to 1 km^2) catchments, though even on this basis the volume of earthworks required was greater than originally estimated. In the search for lower-cost techniques GADP also made use of the sidehill dam, which does not exploit an existing drainage line and catchment area but creates its own catchment by means of wing dams or training walls. This enables catchment and reservoir sizes to be matched relatively easily and within defined cost constraints.

3.2.8 The dam programme ultimately completed 40 dams, less than half the number originally planned. The shortfall was, however, entirely due to the unexpectedly large amount ofearthworks required per dam, over double the appraisal estimate. In terms of total volume of earthworks the dam programme slightly exceeded its original target. This was a good performance, especially since much of the plant was out of operation during the second year of the programme due to manufacturing defects. Cost per dam was ₦47,650, almost three times the estimate, due to the additonal earthwork volume and low plant productivity due to breakdowns. The capital cost of water stored by this programme was about ₦0.81 per cubic metre.

3.2.9 The programme of tapkis (ponds) was drastically curtailed, only of the 160 planned being constructed. Tapkis were not considered a useful addition to water supplies because their shallow depth means that they dry up by the late dry season, which is when they are most needed.

3.2.10 The soil conservation programme made very little progress, partly due to the almost exclusive preoccupation of the Senior Planning Officer with the road programme and subsequently with drawing up the plan for the Bauchi State A.D.P.. Two pilot Intensive Conservation Areas totalling 314 ha. were laid out, but farmers proved reluctant to follow recommended erosion-control practices due to the loss of workable land involved.

3.2.11 Buildings

Despite delays due to late Project start-up, the building programme was about 70 per cent complete by the end of PY3 (1977/78). Targets for numbers of units constructed were met except for intermediate and junior staff housing (see Annex 1, Table A1.3), where the need was less than anticipated due to problems in recruitment and retention of staff.

3.2.12 Construction was almost entirely sub-contracted to local contractors working under Project supervision. Costs were about 15 per cent greater than estimated for the programme as a whole, due mainly to rapid escalation of material and labour prices both nationally and locally in Gombe due to increased investment there. Construction standards in many cases were poor, and will result in high future maintenance costs, though maintenance during the

Project period cost only about 20 per cent of the amount estimated.

3.3.0 Agricultural Extension

3.3.1 In common with all sections of GADP, the extension service experienced great difficulty in recruiting suitable intermediate and junior staff in the numbers required. The field strength of the service never rose to much more than half the level envisaged in the appraisal report, the best agent:farmer ratio achieved being about 1:600, or only half the intensity achieved on Funtua A.D.P. at the same period.

3.3.2 The extension strategy followed was to arouse farmers' interestin innovations by means of mass-communication techniques including motion picures, a weekly radio programme and wall posters, with extension agents following up those displaying interest. The mass communication techniques were effective in reaching a high proportion of farmers (e.g. 74 per cent saw a film show in 1979, see Annex 7, Table A7.16) but the proportion of farmers making closer contact was low (only 9 per cent received a visit from an extension agent in 1979, and only 12 per cent sought advice at a Farm Service Centre). This may have been due to the relatively poor agent:farmer ratio (extension contacts were much more frequent at Funtua) but much effort was wasted in the early years of the Project by emphasising cotton, a crop in which interest was declining due to poor prices. The service was also hampered by lack of recommendations relevant to the prevailing mixed cropping systems, a result of biases in the in the conduct of agronomic research prior to the Project (see 3.5.0 below).

3.3.3 The Project recognised the need to let interested farmers try out offered innovations on a pilot scale which would not involve them in large expenditure or put their food supply and income at extra risk. The 'mini-kit" approach was adopted to meet this need, each kit consisting of the inputs required to plant and grow a 100 m^2. plot of a given crop in accordance with Project recommendations. Mini-kits were introduced in the 1977/78 crop season and were eventually available for cotton, maize and groundnut. They proved a successful method of demonstrating improved technology, but only within the constraints of sole-crop systems which, as already noted, are at variance with accepted local practice, and which have been shown to give inferior returns compared with mixed cropping (see Annex 7, Tables A7.17 to A7.19).

3.4.0 Staffing and Training

3.4.1 The likelihood of staffing problems at all levels was foreseen during the preparation of GADP, due to the relatively small pool of trained manpower in North-Eastern State. In the event the situation was made worse at the senior level by the subdivision of the State into three new States, each requiring to fill a full complement of senior posts. This led to the loss of Nigerians seconded to the posts of Chief Administrative Officer and Chief Engineer at the very start of the Project, and turnover in Nigerian-manned senior posts remained high throughout the Project period.

3.4.2 There was therefore high reliance on expatriate senior staff and the level of Nigerianisation achieved was low. Only four senior

posts, including that of Project Manager, were held by Nigerians at the end of PY5. Turnover of expatriate staff was low, the majority staying for longer than their original contracts specified, but many senior officers were required to undertake additional duties which in some cases almost entirely precluded the discharge of their original responsibilities. Notable in this context are the assignments of the Senior Planning Officer, Senior Evaluation Officer and Senior Training Officer to duties connected with the preparation of the Bauchi State A.D.P., the Senior Planning Officer having previously stood in for the Senior Roads Engineer, who was never appointed. Although the experience of these officers was undoubtedly very valuable in the planning process, their diversion without replacements of equal calibre must have had an adverse effect on the success of GADP.

3.4.3 GADP also suffered throughout its life severe shortages of intermediate and junior staff, resulting from competition by both government and private bodies during a period of rapid expansion and investment in Bauchi State. The Commercial Services division never had more than 40 per cent of its established intermediate staff, and the staffing of the Accounts Section was also a perennial problem, much of the work having to done by school-leavers with no professional qualification. Shortage of skilled mechanics also threatened Project operations, largely because those trained by the Project frequently found better-paid work elsewhere. In junior staff the problems of the extension service have already been noted (see 3.3.1 above) and the Evaluation Section also found great difficulty in recruiting field staff in

the early years; in both cases the main problem was the unwillingness of literate personnel to work in isolated rural environments.

3.4.4 In view of the severe and sometimes critical staff shortages at GADP it is unfortunate that no full-time Senior Training Officer was appointed until PY4 and that when appointed much of his time was taken up by preparation of BSADP. During the first three years of the Project the Project Manager handled training and staff development matters, with two expatriate volunteer instructors in engineering and a Nigerian instructor in agriculture. There was no fully developed Project training centre until the completion of facilities at Dadin Kowa in PY5.

3.4.5 Most sections of the Project developed their own training arrangements, ranging from informal on-the-job training for junior staff to attachment of mechanics to local plant dealers handling types used by the Project. In addition major efforts were made to improve the supply of intermediate level staff by releasing suitable personnel for certificate and diploma courses lasting up to two years; in the last three years of the Project about 90 staff members attended such courses.

3.5.0 Research

3.5.1 The research programme under GADP was in many respects the most comprehensive attempted on any of the first-generation ADP, and the standard of conduct of the trials and the speed of reporting remained good throughout the Project period. The Project, with the assistance of the APMEPU Chief Agronomist, took particular

care to establish liaison with major research bodies, notably the Institute for Agricultural Research (IAR) and the International Institute for Tropical Agriculture (IITA), and with major commercial suppliers of agricultural inputs. A large proportion of the trials conducted were on behalf of such bodies. A schedule of trials conducted is given in Annex 2, Tables A2.1 - A2.4.

.5.2 The trials conducted on GADP covered a wide range of variety, fertiliser, and disease and pest control investigations on the major crops of the Gombe area. Extensive use was made of the opportunity offered by the network of Farm Service Centres for conducting observation trials under the full range of conditions found on the Project. Two lines of research are particularly noteworthy. In 1979/80 both IAR and IITA organised trials on mixed cropping, the first on any ADP, and the results of the maize/cowpea trials were sufficiently impressive to form the basis of an extension recommendation for the following season. Also, from 1977/78 onwards both the Project and major chemical companies conducted trials on the use of herbicides to control weeds in the more important crops of the Project area. The results of this work were successfully applied on Project seed farms, but the greatest benefits would stem from their application on small farms, where weeding labour requirements are a major bottleneck in raising productivity. Herbicide recommendations for maize and groundnut were included in the cropping recommendation for 1980/81, but are not yet avaialble for sorghum, which is probably where they are most immediately needed. Herbicide recommendations are only available for sole cropping, due to the varying suscepti-

bility of different crops to toxicity, but sole crops are becoming more important for other reasons and it is sole crops which would most immediately benefit from breaking the labour bottleneck (see 6.6.6 below).

3.6.0 Seed Multiplication

3.6.1 The GADP appraisal report projected a requirement for improved seeds totalling some 1200 tonnes per year by PY5, with an implied need for about 950 hectares of land for seed multiplication, part on Project farms and part supplied by outgrowers. These estimates were based on assumptions which proved fallacious, including the expansion of cotton and groundnut area and the rapid adoption of improved varieties for groundnut and sorghum.

3.6.2 GADP nevertheless proceeded with an ambitious programme of seed multiplication, including the construction of a seed cleaning and packing plant at Gombe with a capacity of 1000 tonnes per year. Land availability was a constant problem up to the 1979/80 season, due to conflicting policies within the State Ministry of Agriculture on the use of the Dadin Kowa Estate. This was originally allocated for seed production, but portions were later designated for smallholder irrigation and commercial vegetable farming. The problem was ultimately resolved by the allocation of a further farm at Garin Tafida, and by much heavier reliance on outgrowers than originally planned.

3.6.3 Yield performance for direct Project production was generally poor, due partly to the problems of developing new land, but also to organisational problems. A Project analysis of cost of seed

production for 1977 and 1978 showed the very high figures of ₦774 and ₦661 per tonne respectively. In contrast, the outgrowers, who were large-scale farmers in the Project area, achieved generally good yields (see Annex 3, Table A3.1). From 1979 onwards the policy was therefore adopted of using outgrowers alone to produce cereal and legume seed, although in practice some nucleus seed was still grown on Project farms. The main activity of the Project farms, however, was multiplication of cotton seed under the National Cotton Breeding Programme. In view of the falling cotton area on GADP at this time, this activity was largely irrelevant to achievement of the Project's objectives.

3.6.4 The seeds programme on GADP, like those on other ADPs at the same period, was over-ambitious and poorly executed. The most successful aspect of the programme was the use of outgrowers, though the efforts devoted to this were to a large degree wasted because of faulty market assessment. This reached its peak in 1978, when only 195 tonnes out of the outgrowers' total production of 758 tonnes of certified maize seed were actually purchased by the Project.

3.7.0 Farm Inputs

3.7.1 Fertiliser

One of the main thrusts of GADP strategy was to increase the availability of fertiliser, and considerable success was achieved in this (see Annex 4, Table A4.1), the level of supply in PY5 being nearly ten times that in PY1. At the same time, fertiliser supply per hectare of cultivated land was significantly lower than

on other ADP's in the same period, peaking at about 45 kg. per hectare in 1979/80 (PY5). Project documents state that there were also signicant non-Project fertiliser supplies through cooperatives operating in the GADP area, though the small extent of fertiliser use (see 6.4.9 below) makes it unlikely that such supplies were large.

3.7.2 Deliveries of fertiliser to GADP were adequate until 1979, when little of the year's supply arrived in time for use that season; this applied particularly to phosphates for basal application, which were needed early in the season. Major problems were averted because stocks had been carried over from previous seasons when deliveries had exceeded sales, but Project sources consider that the market was undersupplied in 1979. Similar events occurred in 1980, and it is clear that inadequate supplies were becoming a serious constraint on fertiliser use. This has serious implications, in view of the need to broaden the base of fertiliser use (see 6.6.6 below). The deterioration in fertiliser deliveries coincided with the take-over of this function by the Federal Government Fertiliser Procurement Unit, an experience paralleled on other ADPs.

3.7.3 Chemicals

GADP grossly overestimated the demand for cotton spraying, and a large part of the stock of chemicals for this purpose was eventually sold to the Nigerian Cotton Board (see Table A4.1). Lack of demand was due to declining cotton area and to the prevalence of late planting, whereas only early planted cotton gives economic returns to spraying. The only categories of

chemicals to gain ready acceptance were seed dressings and crop storage insecticides, which are easily incorporated in existing farming systems.

3.7.4 Seeds

As already noted (3.6.0 above) demand for improved seeds was in general heavily overestimated, and much Project seed production was destined for sale outside GADP. A significant demand for improved maize seed developed in the last years of the Project, about half the maize growing farmers stating that they used improved seed in 1980, but even if all their maize area had been planted with improved seed at recommended densities the demand would have been well below the available supply. Uptake of improved sorghum and groundnut seed was negligible, due to preference for existing varieties, and although most cotton was planted with improved seed, the area of this crop declined heavily for most of the GADP period.

3.7.5 Farm Equipment

Sales of cotton-spraying equipment were negligible, for reasons already given at 3.7.3 above. The Project was successful in selling ox-drawn tillage equipment, almost entirely of the Emcot ridger type. Exact figures for number of equipments sold are not available for the period after 1978/79, but it appears likely that total sales up to 1980/81 exceeded 8,000 and that sales within the originally scheduled Project period exceeded the appraisal estimate of 5,000. These sales were additions to a stock of ox-drawn equipment in the Project area estimated in 1976 at 14,000 sets.

The Project also sold 559 teams of draught oxen (2 per team) trained to work with the type of equipment sold. Ox-drawn equipment and draught oxen are expensive items (N105 and N473 respectively) relative to farm incomes (see 6.7.0 below) and the higher sales are largely attributable to GADP's positive credit policy.

3.8.0 Credit and Marketing

3.8.1 The decision of the Federal Government in 1976 to grant an effective 85 per cent subsidy on the price of fertiliser sharply reduced the need for seasonal credit, and consequently total credit issued by GADP was only 37 per cent of appraisal estimates (see Annex 4, Table A4.2). Seasonal lending was nevertheless by no means insignificant, accounting for 37 per cent of all credit issued.

3.8.2 The largest category of lending on GADP, in contrast to other ADPs at the same period, was medium-term credit for major equipment items. This category consisted largely of ox-drawn tillage equipment and draught oxen, there being little demand for sprayers, which were the other main class of equipment falling under this heading. Lending of this type closely matched appraisal projections until PY5; the fall-back in that year may have been due to credit restrictions imposed at the start of the season (see below). Lending to large-scale farmers was only significant in 1979/80, when loans for 17 tractor and equipment outfits were granted. This was originally conceived as a bridging measure pending the issue of loans by a commercial bank under the Central Bank's Agricultural Credit Guarantee Scheme, but no commercial credit was forthcoming and GADP was left with full responsibility

for the loans.

3.8.3 Credit was issued on the recommendation of a committee of farmers at each Farm Service Centre, the committee also assisting in administering loans and enforcing repayment. Loan recovery in the first season of credit operations (PY2) was only 52 per cent, though by repeated efforts over 95 per cent of that season's loans were eventually recovered. Repayment was also slow in PY3, so in PY4 credit was only made available at FSCs where repayment in PY3 had averaged 80 per cent or more. This eliminated 19 out of 39 FSCs from the credit programme. Application of the same criterion in PY5 left only 14 FSCs eligible, so the criterion was lowered to 75 per cent recovery, enabling 34 FSCs to qualify. Overall loan recovery for the Project period was 85 per cent of repayments due. This is considered statisfactory, in view of the likelihood of further recoveries being made later.

3.8.4 As part of the effort to improve credit recovery cotton markets were re-sited adjacent to FSCs, cotton sales being a principal source of cash, and permanent stalls were erected to reduce delays in market opening. GADP did not however, intervene to any significant extent in commodity marketing, although the Project was licensed as a Local Buying Agent to enable it to intervene in the market if necesary. Marketing activities were mainly confined to supervision and quality inspection.

3.9.0 Rainfall

3.9.1 Rainfall records for selected stations within GADP are shown in Annex 5, Table A5.1. Mean rainfall varies appreciably from sta-

tion to station in the Project area, but is generally in the range 900 to 1000 mm. The 1977 rainy season, the first for which crop yield data are available, was poor at most stations, with negligible rainfall until June and a total only about 70 per cent of normal. Some areas had good late rains in October, but generally the rain stopped abruptly in late September. This rapid tail-off of the rains has been characteristic of most of the GADP period, and may have been a factor in the decline of crops depending on residual moisture for seed-filling and maturation.

3.10.0 Crop Production

3.10.1 Sole Crop Equivalents

Appraisal estimates of crop areas and yields were made in terms of Sole Crop Equivalents (SCE). This is a method for equating mixed and sole cropping by assuming, for example, that a hectare of maize grown as a three-crop mix is equivalent to one-third of a hectare of sole-crop maize, and similarly for other degrees of mixture. As a representation of the true situation it is unsatisfactory on both theoretical and practical grounds. In traditional practice neither stand densities nor yields actually decline in direct proportion to the number of crops in the mixture, and a growing body of research shows that this need not be the case with improved methods either. This means that the hectare of maize in three-crop mixture is in fact equivalent to more than one-third of a hectare of sole-crop. By undervaluing mixed-crop areas the SCE method inflates the SCE yield for any crop grown in mixture, and when, as at Gombe, there have been major changes from mixed to sole cropping, or between degrees of mixture, the resulting bias

will not even be constant over time. The SCE method is also severely affected by error or inconsistency in reporting crop mixtures, since the inclusion or omission of a minor mixture component will change the correction factor used in determining the SCE equivalent.

3.10.2 For these reasons it is considered highly preferable to present crop data in terms of unadjusted area, distinguishing between different mixtures where necessary. The data in Section 6 of this report are presented in this way, but to provide a comparison with the original appraisal projections SCE areas and yields are presented in Table 3.1. Because of the late start-up of GADP, the comparisons in Table 3.1 have been lagged by one year, so that the PY2 appraisal estimates are compared with 1977/78, which was the true second year of implementation, rather than the third as originally scheduled.

3.10.3 Cotton

The appraisal report envisaged an expansion of cotton production by 117 per cent, based on a 90 per cent yield increase and a small increase in crop area. In the event, area and production fell sharply up to and including 1979/80 (PY4), due to unfavourable prices, the trend only being reversed when prices increased in 1980/81. Uptake of the improved technology needed to raise yields was negligible. Fertilisers were not used because of the poor cotton price, and spraying was not adopted because it requires early planting, which in turn produces competing labour demands with food crops, which normally have priority.

TABLE 3.1

GOMBE A.D.P.: ACTUAL AND ESTIMATED PRODUCTION OF MAJOR CROPS, WITH SOLE CROP EQUIVALENT AREAS AND YIELDS ('000 TONNES, '000 HA., KG./HA.)

1/ 2/ 3/

		PY1 (1976/77) 4/			PY2 (1977/78)			PY3 (1978/79)			PY4 (1979/80)			PY5 (1980/81)		
		A	E	%A/E	A	E	%A/E	A	E	%A/E	A	E	%A/E	A	E	%A/E
COTTON: 5/	PROD'N	NA	16.95	NA	20.37	18.23	112	16.34	21.16	77	9.32	27.08	34	23.56	36.84	64
	AREA	NA	52.80	NA	32.34	53.30	61	25.67	53.20	48	18.47	56.30	33	32.45	60.80	53
	YIELD	NA	321	NA	630	342	184	637	398	160	505	481	105	726	606	120
COWPEA:	PROD'N	NA	1.16	NA	2.66	1.31	203	3.60	1.56	231	12.73	1.93	659	7.75	2.24	346
	AREA	NA	5.15	NA	13.65	5.30	258	7.81	5.60	140	39.13	5.90	663	18.09	6.20	292
	YIELD	NA	225	NA	195	247	79	461	279	165	325	327	99	429	361	119
G'NUT: 6/	PROD'N	NA	5.38	NA	9.10	6.13	148	10.94	6.83	160	6.36	8.60	74	3.72	10.80	34
	AREA	NA	10.38	NA	9.03	10.75	84	14.06	10.65	132	14.82	11.20	132	6.84	12.60	54
	YIELD	NA	518	NA	1008	570	177	778	641	121	430	768	56	544	857	64
SORGHUM	PROD'N	NA	48.72	NA	110.74	49.98	222	122.54	52.50	233	116.18	54.60	213	81.32	57.12	142
	AREA	NA	69.60	NA	97.72	66.90	146	116.20	64.50	180	125.00	60.00	208	97.43	57.60	169
	YIELD	NA	700	NA	1133	747	152	1055	814	130	929	910	102	835	992	84
MAIZE:	PROD'N	NA	3.00	NA	7.77	5.29	147	7.85	11.75	67	17.32	23.43	74	60.27	37.53	161
	AREA	NA	3.75	NA	8.19	5.40	152	9.29	9.38	99	17.22	15.25	113	39.06	22.95	170
	YIELD	NA	800	NA	949	980	97	845	1253	67	1006	1536	65	1543	1635	94
MILLET: 7/	PROD'N	NA	NA	NA	48.30	NA	NA	58.68	NA	NA	49.14	NA	NA	35.57	NA	NA
	AREA	NA	NA	NA	47.60	NA	NA	46.92	NA	NA	43.20	NA	NA	22.12	NA	NA
	YIELD	NA	NA	NA	1015	NA	NA	1251	NA	NA	1137	NA	NA	1608	NA	NA
NO. OF HOUSEHOLDS		68000			70000			72000			74000			76000		

FOR NOTES, SEE OVERLEAF

NOTES TO TABLE 3.1

1/ ACTUAL FIGURES (A) FROM EVALUATION STUDIES, ESTIMATES (A) FROM PROJECT APPRAISAL REPORT.

2/ FOR DERIVATION OF PRODUCTION ESTIMATES, SEE ANNEX ON DATA QUALITY.

3/ SOLE CROP EQUIVALENT AREA FOR A CROP GROWN IN MIXTURE IS THE AREA UNDER THE MIXTURE DIVIDED BY THE NUMBER OF CROPS IN THE MIXTURE. TOTAL SCE AREA IS THE SUM OF SCE AREAS FOR INDIVIDUAL MIXTURES. SOLE CROP EQUIVALENT YIELD IS TOTAL PRODUCTION DIVIDED BY TOTAL SCE AREA.

4/ ACCORDING TO ORIGINAL PROJECT SCHEDULE, PY2 IS 1976/77, BUT DUE TO DELAYS IN START-UP THE APPRAISAL ESTIMATES FOR PY2 HAVE BEEN COMPARED WITH 1977/78. NO APPRAISAL STUDIES CONDUCTED IN 1976/77.

5/ SEED COTTON.

6/ SHELLED NUTS.

7/ NO APPRAISAL ESTIMATES MADE FOR THIS CROP.

3.10.4 Cowpea

The importance of cowpea was seriously underestimated by the appraisal report. Yields were generally close to estimates, but area and production, while fluctuating, were much higher, and compea made major production gains under GADP. These were largely due to the ability of the crop to fit into changing cropping systems, there being no adoption of the recommended package of improved methods.

3.10.5 Groundnut

The appraisal report envisaged a major increase in groundnut production due mainly to yield improvements. In reality the crop declined in yield, area and proudction, being of only minor importance by the end of GADP. A run of poor seasons may have contributed to this, but groundnut, which was mainly grown in mixtures, seem to have been one of the main victims of the move towards simpler cropping systems.

3.10.6 Sorghum

Appraisal projections recognised the position of sorghum as the main traditional cereal staple, but underestimated its area and prodction. Both appear to have declined in the final years of GADP due to the replacement of sorghum by maize in mixed cropping. The apparent decline in SCE yields is spurious, resulting from a major shift towards sole cropped sorghum (see 3.10.1 above), and yields have been very steady. There has been very little uptake of improved methods and inputs for sorghum, except in the use of ox-draught cultivation to reduce labour demand in sole cropping.

3.10.7 Maize

Maize area, yield and production expanded strongly in the later years of GADP, exceeding appaisal targets by PY5. Most of the fertiliser used on the Project was devoted to this crop, and there was appreciable uptake of improved varieties, but little adoption of other improved practices. Maize production gains were the major contributor to the net benefits of GADP.

3.10.8 Millet

Millet appears to have suffered particularly severely from competition with maize, which has a much higher yield while sharing the property of relatively early maturity. It has been displaced from many two-crop mixtures by maize while at the same time decreasing in total area and production. The apparent increase in SCE yields is spurious, resulting from an increased proportion of more complex mixtures (see 3.10.1 above). Millet was ignored by the appraisal report, despite its position as the second most important crop at the start of GADP.

3.10.9 Incremental Production

The incremental volume of production for major crops in the GADP period is shown in Table 3.2, with the equivalent values at 1979 mean producer prices. As for Table 3.1, comparisons with appraisal estimates are lagged a year to compensate for late start-up. Incremental values are on the base of PY2, due to the lack of evaluation data from PY1.

3.10.10 The total value of incremental production from 1977/78 to 1980/81 was N13.55 million, or about 35 per cent of the value implied by

GOMBE A.D.P.: ACTUAL AND ESTIMATED INCREMENTAL PRODUCTION OF MAJOR CROPS, BY VOLUME AND VALUE, 1976-80. 1/

('000 TONNES AND MILLION NAIRA)

		PRODUCTION, PY2 2/ (1977)	INCREASE OVER PY2 PY3	PY4	PY5	TOTAL INCREMENT ('000 TONNES)	INCREMENTAL VALUE 3/ (MILLION NAIRA) A	E
COTTON: 4/	(A)	20.37	-4.03	-11.05	3.19	-11.88	-3.56	
	(E)	18.23	2.93	8.85	18.61	30.39		9.12
COWPEA:	(A)	2.66	0.94	10.07	5.09	16.10	7.76	
	(E)	1.31	0.25	0.62	0.93	1.80		0.87
GROUNDNUT: 5/	(A)	9.10	1.84	-2.74	-5.47	-6.37	-2.72	
	(E)	6.13	6.83	8.60	10.80	26.23		11.23
SORGHUM:	(A)	110.74	11.80	5.44	-29.42	-12.18	-2.85	
	(E)	49.98	2.52	4.62	7.14	14.28		3.34
MAIZE:	(A)	7.77	0.08	9.55	52.50	62.12	15.28	
	(E)	5.29	6.46	18.14	32.24	56.84		13.98
MILLET: 6/	(A)	48.30	10.38	0.84	-12.73	-1.52	-0.36	
	(E)	NA	NA	NA	NA	NA		NA
							13.55	38.54

NOTES:
1/ ACTUALS (A) FROM EVALUATION STUDIES, ESTIMATES (E) FROM PROJECT APPRAISAL REPORT.
2/ ACCORDING TO ORIGINAL PROJECT SCHEDULE, PY2 IS 1976/77, BUT DUE TO DELAYS IN START-UP THE PY2 APPRAISAL ESTIMATES ARE COMPARED WITH 1977/78 ACTUALS, AND SIMILARLY FOR ALL YEARS.
3/ AT 1979 MEAN PRODUCER PRICES (FROM EVALUATION PRICE SURVEY).
4/ SEED COTTON.
5/ SHELLED NUTS.
6/ [illegible] ESTIMATES [illegible]

appraisal production estimates. The shortfall stems almost entirely from the lack of gains in cotton and groundnut production, the former due to unfavourable pricing and the latter to adverse developments in the cropping systems, some of them probably caused by Project activities (see Section 6.4.0 - 6.6.0 below). Farmers' response to poor cotton prices was entirely logical and beyond Project managment's control, but some of the effects might have been counteracted by, for example, reducing the extension emphasis on cotton in favour of maize.

4.0 INSTITUTIONAL PERFORMANCE AND DEVELOPMENT

4.1.0 Organisation

4.1.1 The organisational structure adopted differed in some respects from that given in the appraisal report. The Credit Services and Market Services Sections were combined as a single Commercial Division handling input supplies, credit and market supervision. A Training Section, not provided for in the appraisal structure, was established in 1977 to help counter the chronic shortage of skilled staff and the lack of a coherent staff development programme.

4.2.0 Staffing

4.2.1 Considerable difficulty was experienced in securing and retaining Nigeriam staff at all levels, due to the competing demands of government and private organisations for the limited pool of skilled manpower in Bauchi State. Progress in Nigerianisation of senior posts was erratic, and only four were filled by Nigerian personnel by the end of the Project. Continuity in Nigerian

filled posts was poor, there being three Chief Administrative Officers and four Chief Technical Officers in the Project period.

4.2.2 Recruitment of expatriate staff was delayed by the late Project start-up and some posts were not filled until the middle of PY2 (1976/77). No Senior Road Engineer was ever recruited. Turnover of expatriate staff was low, but a number of senior personnel were diverted from Project duties to planning the Bauchi State A.D.P. and thus made only a limited contribution to Project objectives.

4.2.3 Shortages of intermediate and junior staff were chronic throughout the Project period, despite intensive recruitment efforts and the provision of training both within and outside the Project. All sections of the Project suffered to some extent, but extension, mechanical maintenance and the Commercial Division were especially badly affected.

4.3.0 Supporting Services

4.3.1 These included Management and Administration, Accounting Services, Commercial Division, Technical Division, including Land Use Planning, Training Section and Evaluation Section. Most of these divisions operated statisfatorily and in general achieved target objectives. Exceptions were:-

(i) Engineering Division This Division failed to achieve its revised target for road construction. This was due partly to construction to a higher standard and under more difficult conditions than originally envisaged, but also to breakdown of poorly-selected plant. The Division

suffered from the lack of a full-time specialist Road Engineer.

(ii) Evaluation: The section did not adhere to consistent policies for sample definition and as a result parts of the data series are difficult to reconcile with each other. These problems are considered to stem from the diversion of the Senior Evaluation Officer to other duties and to lack of continuity among his successors. Due to lack of data-processing facilities, results from the major surveys were not presented in time to be a guide to managment in project implementation.

5.0 FINANCE

5.1.0 Funding

5.1.1 It was originally intended that the funding of GADP should be divided almost equally between the World Bank and Nigerian sources, mainly the State Government (see Annex 6, Table A6.1). In the event the contribution of the World Bank, which was a fixed dollar sum, was reduced by exchange rate movements strengthening the Naira against the U.S. dollar. The State Government's contribution was also reduced, but additional Nigerian funding was supplied by the Federal Government, mainly in the form of fertiliser supplies. A planned contribution from the proceeds of input sales substantially failed to appear, due to the high operating costs of the GADP Commercial Division. Total funds eventually supplied during the GADP period were over 98 per cent of original estimates. There were no serious delays in receipt of funds, except in 1978/79 when the State Government's contribution

was never made and Federal funding was half the expected level, but this caused no serious problems since the Project by then had adequate cash reserves.

5.2.0 Disbursements under IBRD Loan

The World Bank loan did not become effective until November 1976, due to problems in Project start-up, especially the filling of senior posts. Disbursements under the loan began in the first half of 1977 and by the end of 1980 total disbursements had reached 96 per cent of the estimated total (see Annex 6, Table A6.2). About US $ 1.0 million of the loan was held in reserve for use as bridging funds during the transition to Bauchi State A.D.P..

5.3.0. Actual and Estimated Project Costs

5.3.1 The total costs of GADP for its originally scheduled life were about ₦26.1 million, or about 12.5 per cent below original estimates (see Annex 6, Table A6.3). The saving was almost entirely due to the lower than estimated costs of farm inputs, especially fertilisers, and almost all categories of goods, services and personnel in fact cost substantially more than originally estimated, despite understaffing and the under-achieve-ment of some construction programmes. These cost overruns were in part due to the very rapid inflation affecting Nigeria during the GADP period, though some were due to factors at least partly under Project control, as in the case of high plant operating costs.

5.3.2 If costs are allocated by operating division of the Project (see Annex 6, Table 6.4) a similar pattern appears. The only division

with costs very substantially below estimate was Commercial Services, which, except in the case of fertiliser, had a much lower throughput than expected and which was chronically understaffed. The only other division to show a saving was the Evaluation Section, which was relatively little affected by inflation because much of its costs were in salaries.

5.4.0 Accounts and Audit

5.4.1 The Accounts Section of GADP suffered severely from shortage of qualified staff, and was consequently unable to provide the cost accounting service originally expected from it. The situation would have been worse if the Commercial Services division had not been able, under the supervision of its manager, to maintain its own systms of financial control, though this dual structure allowed inconsistencies of practice to appear. Lack of consolidated accounting for the main Project and Commercial Services also led to confusion over the size of the cash balances held, at a time when, due to delayed funding (see 5.1.1 above), such information was important.

5.4.2 The audit of GADP accounts was performed by Pannell Kerr Foster, Chartered Accountants, throughout the Project life. The auditors indicated that the financial statements submitted fairly indicated the financial position of the Project.

6.0 EVALUATION STUDIES

6.1.0 General

6.1.1 Provision was made in the design of Gombe A.D.P. for the establishment of an Evaluation Unit having responsibility for gathering data on which to base assessments of the effects of the Project and according to which Project management could modify its policies. Technical standards for data gathering, and analysis above the basic level, were to be provided by APMEPU. Due to the delay in Project start-up, the major agronomic and farm management surveys were not conducted in 1976/77. Shortage of enumerators and lack of continuity in the leadership of the Unit caused problems of data quality and readers are strongly advised to consult Annex 8 in connection with the crop yield and area data in this section. Due to lack of adequate data-processing facilities data were never, during the period covered by this report, analysed and reported fast enough for them to be used as a policy guide by Project management. They are, however, available to indicate the effects of the Project and to give guidance for future developments.

6.2.0 Surveys

6.2.1 The Evaluation Unit was required to produce data which would support quantitative estimates over the whole Project of trends affecting the small farmers who are the great majority of the population. This dictated the adoption of random sample survey techniques. This methodology was appropriate for the primary task undertaken, but is not well suited to the investigation of the detailed mechanisms by which change takes place at farm level, or

to finding out about large farmers who, though a small minority in number, control a significant proportion of land and other resources. For these tasks a case-study approach is appropriate. Case studies require large amounts of highly-skilled manpower to give good results, and were therefore never a serious possibility given the constraints experienced at Gombe, but future studies could usefully combine the two approaches.

6.2.2 Table 6.1 shows the main survey programmes conducted by the GADU Evaluation Unit. The Village Listing survey is conducted in the opening year of all A.D.P's in order to give a complete listing of all settlements from which subsequent random samples can be drawn. It also gives a preliminary estimate of the population of the Project area, but this normally requires to be deflated in the light of the more detailed Baseline survey which follows. Baseline also provides data on the relative importance of different crops, on family resource endowments for agriculture, and on household income and expenditure. Both Village Listing and Baseline are normally repeated at the end of Project life.

6.2.3 The major surveys during Project life are a farm managment, income and expenditure survey which at Gombe went through successive revisions known as Punchline and Deadline, and an agronomic survey which collects data on crop areas and yields and agronomic practices. In addition the Price Survey provides data for valuing production and consumption, while the Extension and Agricultural Knowledge Surveys investigate the methods and the effectiveness with which the Project imparts information to the farmers. Besides

TABLE 6.1

GOMBE A.D.P.: EVALUATION SURVEYS CONDUCTED

1976/77:	Village Listing
	Baseline
	Agronomic
	Prices
	SOAK
	Credit and Marketing
	Water Resources
	Water Sources Preference
	Ox-bull and Plough
	Snake-bite
	Cotton Markets.
1977/78:	Punchline
	Agronomic
	Prices
	SOAK
	Dam utilisation
	Road utilisation
	Extension aids
	Extension mini-kit
	Tractor Hire
1978/79:	Punchline
	Agronomic
	Prices
	Dam utilisation
	Road utilisation
	Work bulls
	Film show impact
	Radio programme impact
1979/80:	Deadline
	Agronomic
	Village Listing
	Prices
	Vehicle use
1980/81:	FRADYS[1]
	Prices

1/ "Field Record for Agronomic Data, Yields and Stands", the latest revision of the agronomic survey.

these major surveys, for which standard formats are supplied by APMEPU, surveys on a variety of topics were conducted to fill data needs defined by Project Management, APMEPU, the Evaluation Unit and other research bodies.

6.3.0 Population and Farm Sizes

6.3.1 The 1975/76 and 1980/81 Village Listing exercises, as adjusted in the light of Baseline survey results, indicate total populations of 58,000 and 76,000 respectively. This implies a growth rate of 5.6 per cent per year, which is double what could be expected from natural growth. The two figures do not, however, relate to precisely the same area, since GADP was slightly enlarged after the 1975/76 Village Listing. The population growth rate has therefore been assumed to be 2.5 per cent per year for the purposes of the present report and population figures have been projected backwards from the 1980/81 estimate.

6.3.2 Farm size estimates for GADP are characterised by a number of problems which have led to rejection of the data for 1978/79 and 1979/80 (see Annex 8 for details). The data for 1977/78 and 1980/81 (see Annex 7, Table A7.1) suggest that mean farm size has actually increased over the Project period (difference of means significant at P = 0.99). This is surprising, given that the rural population is almost certainly increasing strongly, and that the GADP area was already relatively intensively cultivated at the start of the Project; the 1977/78 population and farm size estimates imply a cultivated fraction of at least 40 per cent. On the other hand many areas bordering GADP have much lower cultivated

fractions, some below 20 per cent, possibly implying scope for opening new land. Further, there were, as will be discussed below, a number of agronomic developments during Project life compatible with expanding farm size. This report therefore proceeds on the basis of a geniune increase in farm size between 1977/78 and 1980/81, and farm sizes for the two intervening years have been interpolated linearly between them.

6.3.3 The hypothesis of relatively free access to land receives some support from the slight decline of the Gini coefficient for land ownership over the 1977-81 period (see Table A7.1). This indicates that there was a slight reduction in the inequality with which land was distributed among in the farmers surveyed (a Gini coefficient of 0 indicates complete equality, and of 1, complete monopoly by one unit). For policy measures it is important to note that the distribution of farm size is skewed, with the majority of farms falling below the mean. Policies aimed at the mean may well, therefore, be inappropriate for a large proportion of farmers.

6.4.0 Agronomic Practices

6.4.1 Land Preparation

In the early years of GADP hand cultivation predominated for most crops, with ox-drawn equipment being an important minority option and tractors of negligible importance (see Annex 7, Table A7.2). During the Project a very rapid uptake of ox-drawn cultivation took place, with some 67 per cent of land for major crops being prepared by this means in 1980/81. Although weeding, rather than land preparation, is the major labour bottlereck limiting the

amount of land farmers can cultivate, the substitution of ox-draught for hand cultivation should permit some increase in area cultivated, especially if crop mixtures are simplified to allow more use of ox-drawn equipment for weeding as well as seed-bed preparation. There are some signs that this has happened. The rapid growth in use of ox-drawn implements agrees well with the large number sold by the Farm Service Centres (see 3.7.5 above and Annex 4).

6.4.2 Mixed Cropping

GADP's main development effort was the attempt to raise small farmers' production by encouraging them to adopt packages of improved practices for the major crops. Initially these packages were couched entirely in terms of cropping in a pure stand (sole cropping) because most of the research conducted in Nigeria, and all the published recommendations, were on that basis. At an early stage in the Project's life it was appreciated that the predominant practice of the area was mixed cropping, but only in 1980/81 were the first mixed cropping recommendations issued by the extension service; these recommendations owed much to the cooperation in agronomic research between GADP and the research bodies (see 3.5.0 above). In the interim the extension service adhered to sole cropping recommendations inappropriate to much of the cropped area.

6.4.3 Over the period of the Project there was a distinct movement for most crops towards simplification of crop mixtures (see Annex 7, Table A7.3), with complex mixtures of four or more crops almost

disappearing. Sole cropping increased for cotton and sorghum where it was already an important minority option, and for groundnut and maize, where it had previously been of little importance. Millet and cowpea did not show any significant movement towards sole cropping, and in the case of millet three-crop mixtures actually expanded at the expense of two-crop mixtures; this may be connected with a parallel sharp decline in millet area, which seems to be being displaced from many two-crop mixtures by the higher-yielding maize.

6.4.4 The increase in sole cropping is of interest in connection with the increase in ox-cultivation already noted and with the apparent increase in farm sizes. Crop budget studies for broadly similar environments on Funtua and Gusau ADP's (see Annex 7, Tables A7.17 and A7.18) show that sole-cropped sorghum and cotton give inferior returns compared to mixed cropping. The inferiority of returns to land is marked, but is relatively small for return to labour. On the other hand, sole cropping requires much smaller labour inputs per hectare than mixed cropping, making it an option for the farmer with a high land endowment relative to his other resources. If labour productivity can be raised by using ox-power, the attractiveness of sole-cropping systems would be enhanced for farmers with access to the extra land needed to offset the lower returns per hectare.

6.4.5 Time of Planting

Farmers traditionally and correctly time crop plantings according to the incidence of rainfall, rather than a calendar date, and allocate relative priority for planting on the basis of assuring

household cereal staple requirements and of avoiding clashing labour requirements for weeding later in the season. Thus bulrush millet, chosen as a security crop because it is the hardiest cereal in the Gombe area, is usually planted earliest so as to have the best chance of maturing even in a short rainy season. Sorghum, the major traditional cereal staple, follows shortly after when the rains are better established, since it is less drought-resistant. Crops grown for both consumption and sale, such as maize and groundnut, have next priority, while cotton, which is grown purely for sale, is usually sown very late. Cowpea planting varies widely, but a typical pattern is to interplant it among the early crops half-way through the season. This addition is essentially free in terms of yield reduction to the early-planted crop, since the cowpea stand density is low and the period of overlap in the field is not long. These patterns were maintained throughout Project life, despite efforts, for example, to persuade farmers to plant cotton earlier, but the calendar dates for planting varied widely according to the season. In the late-starting season of 1977/78, for example, all crops were planted from two to five weeks later than in the good 1978/79 season (see Annex 7, Table A7.4).

6.4.6 Stand Density

Stand densities for crops in relay or overlap mixed cropping (of the type noted above for cowpea) can be at sole crop levels, but for most mixed crops the density of one or more elements in the mixture must be reduced to avoid undue competition for light and nutrients. Since mixed cropping predominates, stand density re-

commendations based on sole cropping are inapplicable to much of the cropped area. Even amongst the crops grown as sole stands a proportion represent uncompleted mixtures, and will therefore also fall below recommended densities. Sole crop stand densities in GADP were generally no more than two-thirds of recommended levels (see Annex 7, Table A7.5) and densities in mixed crops were lower still.

6.4.7 The decline in density for mixed crops is not, however, directly proportional to the number of crops in the mixture. For example, in 1979/80 the mean stand density for groundnut in a two-crop mix was 83 per cent of the sole crop density and the density of groundnut in three-crop mixes averaged higher than that in two-crop mixes. Such observations demonstrate the inadequacy of simplistic methods of calculating the equivalence of areas of different mixtures on the basis of the number of crops in the mixture.

6.4.8 The only crops for which there was significant movement in stand densities were maize and groundnut. In neither was there an increase in sole-crop densities, despite the increased importance of sole cropping (see 6.4.3 above), giving further indication of the extensive nature of sole-crop enterprises. Rather, there were increases in stand densities for mixed cropping, especially in three-crop mixtures.

6.4.9 <u>Fertiliser</u>

Within the overall GADP strategy of developing small-scale production, one of the most important single strands was the improvement of fertiliser supplies. A major improvement was

achieved (see 3.7.1 above) though progress was slowed in the later years of the Project by late and erratic deliveries. The level of supply per cultivated hectare reached on GADP was only about 45 kg. (two-thirds of that at Funtua) but supplies per hectare actually receiving fertiliser were much higher (over 200kg. per hectare) because the proportion of area fertilised was relatively low, only reaching 22 per cent in 1980/81.

6.4.10 The low proportion of area fertilised may be attributed partly to the pattern of uptake of fertiliser by different groupsof farmers. Adoption was highest among relatively large farmers (see Annex 7, Table A7.7), but these constitute only a small proportion of the population and are more likely to farm their land on a low-input basis. Additionally, there appears to be considerable selectivity in which crops receive fertiliser. By 1980/81 52 per cent of maize area was receiving fertiliser (Table A7.6) but only 20 per cent of millet and a mere 16 per cent of sorghum. Application rate data are not yet available, but it seems likely that maize was not only the most frequently, but also the most heavily fertilised crop. The high response of maizeto inorganic fertilisers is well known and evidently appreciated by farmers, but the low rate of fertiliser use on the traditional cereal staples contrasts with the situation on some other ADPs. This may be anotrher pointer to a situation where low-input methods are an attractive option except in the case of crops such as maize which perform particularly poorly when handled in this way.

6.5.0 Crop Yields, Areas and Production

6.5.1 Cereals

Maize has long been known to have high yield potential in the Guinea Savannah zones of Nigeria, but the crop has traditionally been grown as a minor component in mixtures, with low stand densities and yields inferior to the traditional cereal staples. GADP made a major effort to increase farmers' awareness of the potential of maize and to provide them with the inputs necessary for the expansion of yields. Response to this effort was initially slow, but by 1980/81 had risen three-fold, the number of households growing the crop was up by 45 per cent, and total area under the crop had more than doubled. These results fully justify the emphasis placed on maize, which was the most successful major element of the GADP crop development programme. The slow start is attributable to several causes. The first year of major extension effort was 1977/78 when the uncertain start of the rains would not have encouraged farmers to take up a crop like maize which is particularly vulnerable to drought at some stages of growth. Also, the recommendations available at the start of the Project were all for sole-cropped maize, requiring that the farmers either revise their cropping patterns or themselves undertake the adaptation to mixed cropping of the innovations offered.

6.5.2 As already noted (6.4.8 and 6.4.10 above) there was little adoption of innovations such inorganic fertilisers or higher stand densities forsorghum and millet. It is therefore not surprising that there was little movement in yields (see Table A7.8), any apparent trend being due to the low yields in the poor 1977/78

season. More significantly, both the traditional cereal staples show a pattern of declining household crop area and production, while millet shows a steady fall in the number of households growing the crop. These developments parallel the spread of ox-draught and the rise of maize to major status, and it seems probable that they are linked. The net effect of the changes in cereal areas and yields is to leave household grain production substantially unchanged at around 2300to 2500kg. per year, a level which is ample to ensure subsistence needs for the average family of just over 6 persons. The significance of the trends for the cereals is considered further at 6.6.0 below.

6.5.3 Cotton

Cotton is unique among the major crops of northern Nigeria in that effectively the whole production has to be sold through formal marketing channels at a price which is, nominally at least, subject to governmental regulation. ADP cotton development programmes are therefore liable to be strongly affected by influences beyong the control of Project Management. This was apparent during the period of the first generation ADPs, when the cotton price remained unaltered from 1975 to 1980, at a time when other agricultural prices were rising. The consequence at Gombe, as elsewhere, was a steep fall in the number of producers and in total production from 177/78 to 1979/80, though the single year's data available suggest that recovery was rapid after the 1980 price increase (see Table A7.9). It is difficult to distinguish a yield trend because of the short time series and the low base year, but there was probably a modest increase due to withdrawal

of less completent producers, rather than to adoption of agronomi improvements. Adoption of the spraying package was especial low, as shown by the poor sales of sprayers (see 3.7.5 above); this was partly due to cost, but also because spraying is onl worth while on early-planted cotton, whereas nearly all cotton i planted late (see 6.4.5 above) to avoid clashes with labour requirements for food crops.

6.5.4 Legumes

Groundnut area per household was halved over the 1977/78 to 1980/81 period, while at the same time the number of growers, never very high, also fell, and yields exhibited a fluctuating but generally downward trend. The decline in this crop may be due to a number of factors. Late-season rainfall was poor in three of the four years considered, which may have had a cumulative effect in discouraging farmers from planting the crop. The decline in groundnut area has been almost entirely in that part of the crop grown in mixtures of three or more crops, which may be due to a general movement towards less complex cropping systems, possibly prompted by the adoption of ox-power.

6.5.5 Cowpea, in contrast, has increased in importance despite a similar initial predominance of the more complex mixtures; since cowpea is less affected than groundnut by an abrupt end to the rains, this may add some weight to the hypothesis of climatic causes for the decline of groundnut. In addition to replacing groundnut, cowpeas appear to fit well in mixtures with the increasingly important maize; in 1980/81 about 40 per cent of maize was grown in mixture

with cowpea, an arrangement which research findings have indicated as particularly advantageous (see 3.5.2 above).

6.6.0 Developments in the Cropping Systems

6.6.1 The available agronomic data series for GADP spans only the four years 1977/78 to 1980/81. Conclusions on the evolution of cropping patterns and farming systems must therefore be tentative and subject to revision in the light of further data. Nevertheless, the magnitude of the apparent developments and the importance of their implications for the success of GADP require some analysis, however provisional.

6.6.2 Sorghum and millet yields have not changed significantly over the project period, with the result that the declining areas of these crops have resulted in falling production. This decline has been paralleled by the strong increase in maize area, and more especially yield, so that household grain proudction has remained effectively constant. Maize has therefore, in general terms, tended to replace sorghum and millet, sorghum to a moderate degree and millet to a large degree. Because of the much higher yields achieved by maize in the later years of the Project, the area substitution is on a less than one-for-one basis, which should open the way to increased production of non-cereal crops if the relative importance of mixed cropping is maintained.

6.6.3 The movements in crop areas are not, however, straightforward. Millet appears to have given way to maize across the board, which is not implausible since maize shares to some degree the early maturity which is the chief virtue of millet. In the case of

sorghum, however, it is only sorghum grown in mixture with other crops which has declined, while sole-crop sorghum has considerably increased in area (42 per cent between 1977/78 and 1978/79). The replacement of sorghum by maize in mixtures is explicable in terms of the superior response of maize to higher input intensities, especially of fertiliser. Crop budget studies indicate, and farmers are aware, that returns to resources employed have generally been higher in mixed than sole cropping, so mixed cropping will tend to be favoured in the disposal of additional resources.

6.6.4 The growth in sole-cropped sorghum (and sole-crop cotton and maize also) probably results from the very great expansion of ox-draught tillage during the Project period. As already noted, the inferior returns to both land and labour from sole cropping have in the past prevented it from gaining wide acceptance. The GADP appraisal report estimated, however, that the use of ox-cultivation would result in a net saving of some 200 man/hours of labour per hectare for initial land preparation. Even if this is taken only as an approximate indication of the order of magnitude of the savings possible, it is apparent from the available crop budget studies (see Annex 7, Table A7.16 to A7.18) that the impact on labour productivity would be considerable. The impact would be greatest on sole cropping, which is where land preparation forms the highest proportion of total labour use. Ox-power is little used for post-planting operations, and is difficult to use for some types of mixed cropping, which would account for the differential effect favouring expansion of sole cropping. At the same time, adoption of ox-power for land preparation would be advantageous for mixed

cropping, since a significant proportion of labour is hired for land preparation and the expenditure saved could be applied to other inputs, for example fertiliser or labour for weeding.

6.6.5 The cropping systems on GADP are thus seen to be in the process of adapting to two major influencess; maize as a major cereal crop and ox-power as a method of land preparation. The very large increase in maize production has not as yet resulted in a net increase in household grain proudction because of falling sorghum area uncompensated for by any yield increase. The falling sorghum area in turn stems from the fact that the growth in sole-cropped sorghum which has been facilitated by ox-power has not so far caught up with the decline in mixed-crop sorghum caused by the substitution of maize. Whether these trends will eventually cancel out remains to be seen, since it is possible, and even probable, that the farmers susbstituting maize for sorghum, and the farmers expanding an extensive type of sole sorghum enterprise, are not the same. There is therefore not necessarily a correlation between the rates at which the two movements proceed.

6.6.6 Given the existence of these movements, however, the policy implications are fairly clear. Farmers introducing maize into their mixed cropping systems should be supported with ready availability of the necessary inputs and advice on the merits of different mixture compositions, since this is one of the most direct paths to enhancing the productivity of the mixtures. For the farmers who are moving into low labour-input, ox-power cultivation systmes, the need is for practices and inputs which will increase the productivity of these systems without

sacrificing their benefits as perceived by the farmer. Since low labour requirement is chief among these, farmers are unlikely to accept advice to raise stand densities because with present technology this increases weeding labour requirements. The dessemination of herbicide weed control, already the subject of considerable research at Gombe, would offer a way out of this impasse. The encouragement of fertiliser use on sole stands would be more straightforward, though the benefits of fertilising sole-cropping sorghum are limited by farmers' preference for the traditional tall varieties. Increased fertiliser use on sorghum and other sole crops wioll depend, of course, on its ready availability, since any restriction will lead farmers to concentrate it where they consider its benefits to be greatest - maize grown in mixture, as at present.

6.7.0 Consumption, Income and Expenditure

6.7.1 Data on the quantity of farm produce used for direct consumption are only available for the first two years of the Project life (see Annex 7, Table A7.10) but there is no reason to expect that general standards of nutrition have worsened subsequently. Nutritional standards at the mean are adequate to good, at least in terms of energy intake. In 1977/78, a relatively poor crop year, consumption of the main food crops was suffficient to provide over 2800 kilocalories per person. This represents a good level of nutrition, considering that a large proportion of the population are children with nutritional requirements below adult levels. Perhaps surprisingly, consumption apparently rose from this already good level in the favourable year of 1978/79, though it was

be remembered that the estimates of mean farm size for that year are atypically high and that this probably means that the household size was also higher than in 1977/78. The staple grain requirements for subsistence implied by the consumption data are compatible with the mean production figures estimated from agronomic surveys (see Tale A7.9) and indicate that, allowing for some storage lossess, the mean household level of production normally allows some grain sales. Grain consumption in the years for which data are available was dominated by sorghum and millet, following the pattern of production, but it is worth noting that even the reduced levels of production of these crops later in the Project would be sufficient to satisfy almost all subsistence requirements.

6.7.2 The existence of a saleable surplus is confirmed by the positive balance of crop output value over the value of production consumed in each of the three years for which data are available (see Annex 7, Table A7.11). Equally noteworthy, however, is the relatively high average level of expenditure on purchased foods, exceeding in value the saleable surplus of farm production. These purchased food items consist in part of items which could be, but are not, produced within the household (e.g. many households buy groundnut oil rather than processing their own groundnuts), in part of items which are not available within most households (e.g. meat, fish, eggs, for which the consumption of home production is negligible) and in part of luxury items and beverages. The existence at the mean of overall deficits on the household food account points up the importance of non-farm occupations, which have been recognised in many studies as an integral part of the rural northern Nigerian

economy. These activities contribute at least 25 per cent of gross income, but their net contribution is much smaller because of their high working capital requirements.

6.7.3 Cash expenditures for farming, in contrast, are very low, with a mean of about ₦50 to ₦70 per household per year (a higher 1978/79 figure being associated with the probably erroneous high farm size estimate of that year). Almost all this expenditure is used for hired labour to supplement family labour supplies at peak periods, expenditure on all other inputs not exceeding ₦10 per year. This points up the potential impact of labour-saving innovations such as ox-ploughing and herbicide weeding; a net saving of 10 per cent on hired labour costs would pay for a doubling of mean household fertiliser use. It also points up the need for innovations offered to be very cheap and/or available on credit terms, confirming the correctness of GADP policy in providing credit for, for example, ox-drawn equipment.

6.7.4 Because the distributions of farm size and other resource endowments are skewed, mean data do not necessarily represent the situation faced by the majority of farmers. Although the mean net farm income in 1977/78 was ₦444 (Table A7.11) about two-thirds of households surveyed in that year had net farm incomes below that figure (Table A7.12, interpolated). This further emphasises the need to keep the cost of innovation to the lowest possible level.

6.8.0 Extension Effectiveness and Project Participation

6.8.1 The problems encountered by GADP in recruiting and retaining field extension staff have been noted at 3.3.0 above. The extension

service thus created had a peak agent:farmer ratio of 1:540, distictly poorer than other early ADPs. The effectiveness of the extension service was questioned within GADP during the Project life time [1] and two Surveys of Agricultural Knowledge (SOAK) were conducted in 1978 and 1980 to evaluate the training and performance of the extension service. Both extension agents and farmers were questioned on their knowledge of a range of recommended practices and on items of technical information required for carrying out those practices.

6.8.2 The average level of extension agents' knowledge of improved practices was fair in 1978 and had improved slightly by 1980, though there was some falling away from some of the highest levels of awareness shown in 1978 (Annex 7, Table A7.15A). Agents had an excellent grasp of the contribution of fertilisers to plant growth and a fair appreciation of correct applications rates. It may therefore be concluded that, on the whole, the extension agents had adequately grasped the basic technical data they were required to present to the farmers.

1/ See, e.g., GADP Quarterly Report No. 4, p. 20. Criticism was in some respects unjustified, given the often inappropriate messages extension was asked to convey.

6.8.3 Farmers, not unexpectedly, showed lower levels of knowledge than extension agents, but also their level of knowledge of improved practices decreased between the two surveys. In part this may be attributed to changing emphasis in the extension message, but decrease in appreciation of the benefits of early planting, good seed and use of fertiliser is disturbing in view of the cost and effort devoted to the extension service. Farmers' appreciation of the role of different fertilisers was adequate, but very few indeed knew the more immediately relevant correct application rates for different crops. Extension agents were evidently not highly efficient in passing on information to the farmers. This is partly attributable to the youth, lack of experience and low status of many agents compared with the farmers they were supposed to advise, and partly too the arousal of farmer resistance to the extension message by the dissemination of advice (for example, in respect of mixed cropping) at variance with farmers' experience.

6.8.4 Confirmation of the ineffectiveness of the extension service in a traditional face-to-face role comes from surveys of project participation conducted in 1977 and 1979 (Annex 7, Table A7.16). A very large majority of farmers used Project services of one kind or another, especially the input sales function of the Farm Service Centres, while Project film shows and radio programmes also had a wide audience. Only a small minority, however, had used the F.S.C.'s as a source of information or received a visit from an extension agent. This is partly attributable to the relatively high ratio of farmers to agents, but it would seem, with hindsight, that the Project might profitably have concentrated even

Officer was appointed until 1977. More might have been achieved in crop production if the priority for cotton had been reduced pending improved prices and attention concentrated instead on crops more attractive to farmers.

7.1.4 Project management could reasonably have been expected to adapt its policies on such matters as staff training, where the problem was readily identifiable because internal to the Project structure. Useful modication of extension programmes, however, requires detailed information on the structure of, and on changes in, the farming systems. In this context it is especially regrettable that greater effort was not made to conduct a major agronomic survey in the first year of operations, that Project management fostered lack of continuity in the direction of evaluation work by diverting the SEO to other duties, and that data turn-round was slow. The most disabling of these problems - slow data turn-round - was again largely external to the Project, deriving from the inadequate provision of data-processing facilities at APMEPU. The impression still remains, however, that Project management did not appreciate the need for better understanding of the agricultural and economic systems it was trying to influence.

7.1.5 The lesson of GADP is therefore two-fold. Successful Project implementtation requires an ability on the part of management to adapt its policies in the light of fresh information and changing circumstances both outside and within the Project. The relevant information is not, however, always immediately available, espec-

ially where farming systems are concerned. Success therefore also requires an appreciation of the likelihood of ignorance and the taking of early and effective measures to remove it.

ANNEX 1: INFRASTRURAL DEVELOPMENT

TABLE A1.1

GOMBE A.D.P.: ROAD CONSTRUCTION

(KM.)

	1975/76	1976/77	1977/78	1978/79	1979/80	TOTAL
APPRAISAL TARGET						
SURFACED	10	60.	60	60	60	250
UNSURFACED	50	175	175	175	175	750
TOTAL	60	235	235	235	235	1000
REVISED TARGET						
SURFACED	20	120	120	120	120	500
ACTUAL						
FORMED	30	131	125	82	76	444
SURFACED	18	132	73	90	56	369
RIVER CROSSINGS	0	7	20	21	39	87

ANNEX 1: INFRASTRUCTURAL DEVELOPMENT

TABLE A1.2

GOMBE A.D.P.: DAMS CONSTRUCTED

DAM	MAXIMUM CAPACITY '000 CU.M	EARTHWORK VOLUME '000 CU.M
DOLLI	26.50	5.42
JAMJI	60.90	14.34
LAWANTI	12.50	6.62
DECHERU	255.00	33.00
ZAMFARAWA	87.00	16.00
HARDO DEBA	170.00	18.00
BILLIRI	40.30	10.00
JALINGO	84.70	18.00
TAL I	77.00	6.00
TAL II	169.30	14.50
AYABA	110.50	16.00
TUMU	51.10	27.90
HORAGARI	59.00	21.00
DADIN KOWA	13.60	6.00
HAUDAN ZAMA	165.00	15.00
KURI SEED FARM	13.60	4.00
DUMBU	104.50	11.50
TASHAR KUKA	34.00	7.50
KURJARE	11.40	6.00
LAMBAM	16.00	6.00
KIDDA	16.00	6.00
PINDAGA	11.40	7.00
KOMABANI	16.00	7.00
TUKULMA	16.00	6.00
DAKITI	16.00	6.00
KUMDULUM	16.00	5.50
WURO SHIKE	314.00	34.30
GERKWAMI	54.00	12.60
BULA	19.30	7.40
KAFARATI	4.20	2.50
DEBA FSC	4.20	2.50
KAEL BAGA	75.00	15.00
KALSHINGI	55.00	10.00
KUMOEL	12.00	3.00
KOLAKO	59.30	11.30
GARIN WAJIRI	18.00	4.00
BALASANE	16.00	6.00
WADACHI	33.50	6.50
-	24.00	7.30
-	17.00	7.10
TOTAL	2358.80	429.78
MEAN	59.00	10.75

ANNEX 1: INFRASTRUCTURAL DEVELOPMENT

TABLE A1.3

GOMBE A.D.P.: SCHEDULE OF BUILDINGS COMPLETED (ACTUAL AND ESTIMATED)

TYPE	NUMBER		COST (N '000)	
	A	E	A	E
ADMINISTRATIVE & SERVICE				
HEADQUARTERS	1	1	150	150
COMMERCIAL HEADQUARTERS	1	-	35	-
DEVELOPMENT CENTRES	5	5	85	40
FARM SERVICE CENTRES	50	50	1000	750
WORKSHOP,STORES ETC.			1448	595
HOUSING:				
SENIOR STAFF	14	17	532	391
INTERMEDIATE STAFF	35	49	840	882
JUNIOR STAFF	132	189	726	569
CONTINGENCIES				811
TOTAL			4816	4188

Annex 2 : Research

Table A2.1

Gombe A.D.P.: Research Trials Conducted in 1976/77

Crop	Type of Trial	Conducted by	Remarks
Cotton	Fertiliser and boron	I.A.R.	
Cotton	Lines, multiline and strains	"	
Groundnut	Variety	"	
Groundnut	Fertiliser	"	
Groundnut	Leaf spot control	"	
Sorghum	Variety	"	
Maize	Fertiliser	"	
Maize	Fertiliser and variety	GADP	

Annex 2 : Research

Table A2.2

Gombe A.D.P. : Research Trials Conducted in 1977/78

Crop	Type of Trial	Conducted by	Remarks
Cotton	Fertiliser and boron	IAR	
"	Multiline	"	
"	Potassium response	"	
"	Strains	"	
"	Herbicide	GADP	19 locations
"	Pest attack observation	"	
Cowpea	Variety trial I	IITA	Spreading varieties
"	Variety trial II	"	Intermediate variet
"	Variety trial III	"	Erect varieties
"	Insect resistance	"	
"	Variety	IAR	
"	Storage	GADP	
Groundnut	Variety	IAR	35 locations
"	Fertiliser	"	
"	Leaf spot control	"	
"	Herbicide	GADP	
Sorghum	Herbicide	"	2 locations
"	Variety observation	"	25 locations
Maize	Variety	IAR	2 locations
"	Variety and fertiliser	GADP	"
"	Hybrid variety	"	"
"	Herbicide	"	"

Annex 2 : Research

Table A2.3

Gombe A.D.P. : Research Trials Conducted in 1978/79

Crop	Type of Trial	Conducted by	Remarks
Cotton	Fertiliser	IAR	
"	Strains	"	
"	Variety	"	
"	Herbicide	Elanco	2 locations
"	Pest attack observation	GADP	21 locations
Cowpea	Variety	IAR	2 locations
"	Advanced trials	IITA	
"	Variety and insecticide observation	GADP	21 locations
"	Storage	"	35 locations
Groundnut	Rosette control	BASF	2 location
"	Variety field observations	GADP	21 locations
Sorghum	Herbicide	BASF	2 locations
"	Variety field observations	GADP	21 locations
Maize	Variety	IAR	2 locations
"	Field observations	GADP	21 locations
Millet	Variety field observations	GADP	21 locations

Annex 2 : Research

Table A2.4

Gombe A.D.P.: Research Trials Conducted in 1979/80

Crop	Type of Trial	Conducted by	Remarks
Cotton	Potassium response	IAR	
"	Nitrogen and stand density	"	
"	Lines	"	
"	Strains	"	
"	Herbicide	Ciba-Geigy	2 location
"	Pest attack observation	GADP	10 locati..
Cowpea	Variety	IAR	2 locations
"	Variety	IITA	"
"	Variety	GADP	State - wide
Groundnut	Flowering observation	IAR	
"	Herbicide	GADP	State - wide
Groundnut	Flowering observation	IAR	
"	Herbicide	GADP	State - wide
Groundnut	Flowering observation	IAR	
"	Herbicide	Ciba-Geigy	2 locations
Sorghum	Variety	GADP	State - wide
Maize	Herbicide	Ciba-Geigy	2 locations
"	Variety	GADP	State-wide
Millet	Variety	"	State-wide
Maize/Sorghum/ Cowpea	Mixed Cropping	IAR	
Maize/Cotton/ Sorghum	Mixed Cropping	IAR	
Maize/Cowpea	Mixed crop management	IITA	

ANNEX 3: SEED MULTPLICATION

TABLE 3.1

GOMBE A.D.P.: CROP AREAS AND YIELDS FROM PROJECT SEED FARMS AND OUTGROWERS

		1976/77		1977/78		1978/79		1979/80		1980/81	
		P	O	P	O	P	O	P	O	P	O
COTTON:	HA.	102	0	90	0	160	0	250	0	260	0
	KG./HA. 1/	1121 3/	0	569	0	721	0	NA	0	NA	0
COWPEA:	HA.	2	0	0	0	4	0	19	77	10	0
	KG./HA.	NA	0	0	0	400	0	528	NA	NA	0
GROUNDNUT:	HA.	5	0	16	20	20	0	0	0	3	0
	KG./HA. 2/	NA	0	519	NA	230	0	0	0	NA	0
SORGHUM:	HA.	2	0	45	29	54	0	6	52	24	0
	KG./HA.	NA	0	493	NA	572	0	667	NA	NA	0
MAIZE:	HA.	14	0	160	152	50	293	4	488	58	245
	KG./HA.	2780 3/	0	406	393	550	2584	705	NA	NA	2487
MILLET:	HA.	0	0	0	0	3	0	2	0	6	0
	KG./HA.	0	0	0	0	900	0	NA	0	NA	0
TOTAL AREA:		125	0	321	201	291	293	291	617	361	245

NOTES: 1/ DELINTED SEED. SEED.
2/ IN SHELL.
3/ YIELDS FROM PART OF TOTAL AREA ONLY.

P = PROJECT FARM, O = OUTGROWERS.

ANNEX 4: FARM INPUTS AND CREDIT

TABLE A4.1

GOMBE A.D.P.: SUMMARY OF FARM INPUTS PURCHASED BY FARMERS

	UNIT	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	TOTAL
FERTILISER:								
(1) PHOSPHATE	'000	) 1175	1640	4248	5062	)11324	10418	)45627
(2) NITROGENOUS	TONNES	)	1460	4161	6139	)		)
CHEMICALS	'000 NAIRA	0.80	11.93	18.47	22.52	57.74	23.50	134.96
SEEDS	'000 NAIRA	0.00	17.30	18.47	21.44	15.28	39.31	111.80
SPRAYERS	NUMBER	0	112	82	105	NA	NA	299
OX PLOUGHS	NUMBER	0	818	1688	1150	2176	2396	8228
WORK BULLS	PAIR	0	0	202	233	124	NA	559
TRACTORS	NUMBER	0	0	0	6	17	NA	23

NOTES: 1/ INCLUDING SALES OF N 41,000 TO THE NIGERIAN COTTON BOARD.
2/ AN ADDITIONAL 1300 PLOUGHS SOLD TO BAUCHI STATE COOPERATIVE WHOLESALE FEDERATION.
3/ ESTIMATED FROM SALES VALUES.

TABLE A4.2

GOMBE A.D.P.: AGRICULTURAL CREDIT ISSUED AND RECOVERED 1/

('000 NAIRA)

	1975/76	1976/77	1977/78	1978/79	1979/80	TOTAL
SEASONAL LOANS:	0	88	189	120	317	714
MEDIUM-TERM LOANS:						
(1) NON-TRACTOR 2/	0	84	243	341	205	873
(2) TRACTORS AND EQUIPMENT	0	0	0	5	360	365
TOTAL LOANS:	0	172	432	466	882	1952
LESS: RECOVERIES	0	90	271	436	439	1236
OUTSTANDING						716
LESS: REPAYMENTS NOT YET DUE						467
OVERDUE:						249

NOTES: 1/ TO 31ST MARCH 1980.
2/ MAINLY OX-DRAWN EQUIPMENT AND DRAUGHT OXEN.

ANNEX 5: RAINFALL

TABLE A5.1

GOMBE A.D.P.: MONTHLY RAINFALLL AT SELECTED STATIONS

(MILLIMETRES)

MONTH	GOMBE GINNERY 1976	1977	1978	1979	1980
FEBRUARY - APRIL	62	0	39	34	0
MAY	76	17	73	136	181
JUNE	98	80	135	133	213
JULY	158	83	217	123	200
AUGUST	146	228	277	221	282
SEPTEMBER	254	157	214	175	52
OCTOBER - DECEMBER	105	13	173	0	17
TOTAL	899	578	1128	822	945

MONTH	TUMU FARM 1976	1977	1978	1979	1980
FEBRUARY-APRIL	26	0	59	62	29
MAY	114	34	54	168	89
JUNE	79	98	117	153	102
JULY	201	133	198	141	291
AUGUST	192	185	112	226	211
SEPTEMBER	211	216	164	123	109
OCTOBER - DECEMBER	103	112	79	0	39
TOTAL	926	778	783	873	870

MONTH	KUMO 1976	1977	1978	1979	1980
FEBRUARY-APRIL	110	2	40	27	27
MAY	70	24	61	183	139
JUNE	207	72	148	124	63
JULY	176	93	113	109	194
AUGUST	219	361	210	174	129
SEPTEMBER	244	215	210	201	101
OCTOBER - DECEMBER	139	0	161	27	34
TOTAL	1165	767	943	846	687

ANNEX 6: FINANCE

TABLE A6.1

GOMBE A.D.P.: SOURCE OF FUNDS

('000 NAIRA)

		PY1 1975/76	PY2 1976/77	PY3 1977/78	PY4 1978/79	PY5 1979/80	TOTAL
A. APPRAISAL ESTIMATES							
FINANCED BY:	WORLD BANK	3367	2582	2508	2517	2842	[illegible]
	STATE GOVT.	2136	2141	2362	2719	3339	1264
	INPUT SALES	80	135	226	329	428	[illegible]
	TOTAL	5583	4858	5096	5565	6609	2771
B. ACTUAL FUNDING							
FINANCED BY:	WORLD BANK	76	1529	4676	2838	3063	171[illegible]
	STATE GOVT.	3226	1500	2000	0	1500	872[illegible]
	FED. GOVT.	500	750	2360	840	2252	670[illegible]
	INPUT SALES 1/	0	6	-2	-35	137	10[illegible]
	TOTAL	3802	3785	9034	3643	6952	2721

NOTES: 1/ ACTUAL PROFIT/LOSS ON COMMERCIAL SERVICES OPERATIONS.

ANNEX 6: FINANCE

TABLE A6.2

GOMBE A.D.P.: CUMULATIVE DISBURSEMENTS UNDER THE WORLD BANK LOAN

(MILLION US$)

	1975	1976	1977	1978	1979	1980
ESTIMATED	4.50	8.50	12.00	16.00	20.00	21.00 1/
ACTUAL	0.00	0.00	9.60	14.30	19.30	20.10 2/
ACTUAL AS % OF ESTIMATE	0	0	80	89	97	96

NOTES: 1/ INTENDED DISBURSEMENT SCHEDULE ENDED JUNE 1980.

2/ ACTUAL DISBURSEMENT SCHEDULE ENDED DECEMBER 1980.

ANNEX 6: FINANCE

TABLE A6.3

GOMBE A.D.P.: BREAKDOWN OF ACTUAL AND ESTIMATED COSTS BY MAJOR HEADINGS

('000 NAIRA)

	PY1 1975/76		PY2 1976/77		PY3 1977/78		PY4 1978/79		PY5 1979/80		TOTAL		DEVIATION FROM ESTIM	
	ACTUAL	ESTIMATE	ACTUAL	ESTIMATE	ACTUAL	ESTIMATE	ACTUAL	ESTIMATE	ACTUAL	ESTIMATE	ACTUAL	ESTIMATE	AMOUNT	
PLANT, VEHICLES & EQUIPMENT	295	1024	1419	360	637	208	62	204	94	77	2507	1873	634	
BUILDINGS, HOUSES & CIVIL WORKS 1/	314	1946	1704	1084	2559	631	2249	140	814	234	7640	4035	3605	
STAFF SALARIES	212	637	942	861	1557	1030	1706	1022	2104	927	6521	4477	2044	
VEHICLE & PLANT OPERATION	13	142	158	347	354	354	621	348	513	288	1659	1479	180	
GENERAL SERVICES	181	531	416	473	355	395	346	420	616	372	1914	2191	-277	
FARM INPUTS	0	157	594	493	798	1031	494	1621	724	2025	2610	5327	-2717	
CONTINGENCIES		1115		1156		1309		1372		1778		6730		
TOTAL	1015	5552	5233	4774	6260	4958	5478	5127	4865	5701	22851	26112	-3261	

NOTES: 1/ INCLUDING MATERIALS AND LABOUR FOR ROADS AND DAMS.

TABLE 6.4

GOMBE A.D.P.: BREAKDOWN OF ACTUAL AND ESTIMATED COSTS BY OPERATING DIVISION

('000 NAIRA)

	PY1 1975/76		PY2 1975/76		PY3 1977/78		PY4 1978/79		PY5 1979/80		TOTAL		DEVIATION FROM ESTIMATE	
	A	E	A	E	A	E	A	E	A	E	A	E	NAIRA	%
ADMINISTRATION	427	553	1096	485	1707	310	1265	335	1306	307	5801	1990	3811	192
TECHNICAL SERVICES	316	1059	1224	896	1238	854	1131	498	983	461	4892	3768	1124	30
COMMERCIAL SERVICES	15	915	379	666	628	648	643	467	517	526	2182	3222	-1040	-32
ENGINEERING	243	1494	1860	898	1754	723	1694	745	1137	521	6688	4381	2307	53
EVALUATION	14	159	74	80	115	83	116	89	112	83	431	494	-63	-13
FEASIBILITY STUDIES	0	100	6	100	20	0	135	0	86	0	247	200	47	24
TOTAL DEVELOPMENT EXPENDITURE	1015	4280	4639	3125	5462	2618	4984	2134	4141	1898	20241	14055	6186	44
INCREMENTAL FARM INPUTS	0	157	594	493	798	1031	494	1621	724	2025	2610	5327	-2717	-51
CONTINGENCIES	0	1115	0	1156	0	1309	0	1372	0	1778	0	6730		
TOTAL PROJECT COSTS	1015	5552	5233	4774	6260	4958	5478	5127	4865	5701	22851	26112	-3261	-12

ANNEX 7: EVALUATON STUDIES

TABLE A7.1

GOMBE A.D.P.: DISTRIBUTION OF FARM SIZE, 1977-81

(PERCENTAGE OF FARMS)

FARM SIZE RANGE (HA.)	1977/78	1980/81
0.0-0.9	14	13
1.0-1.9	35	33
2.0-2.9	22	18
3.0-3.9	9	14
4.0-4.9	5	6
5.0-5.9	4	5
6.0-6.9	4	4
7.0-7.9	4	0
8.0-8.9	1	0
9.0-9.9	1	0
10.0+	3	4
MEAN FARM SIZE	2.97	3.45
STANDARD DEVIATION	2.98	2.73
SAMPLE SIZE	231	280
% OF FARMS LESS THAN:		
2.0 HA.	49	46
4.0 HA.	80	78
6.0 HA.	89	89
GINI COEFFICIENT: 1/	.43	.41

NOTES: 1/ THE GINI COEFFICIENT MEASURES THE EVENNESS OF DISTRIBUTION OF A FACTOR (SUCH AS LAND OWNERSHIP) BETWEEN THE CLASSES OF A POPULATION. IT RANGES FROM 0 (= PERFECTLY EVEN DISTRIBUTION) TO 1 (= COMPLETE INEQUALITY, WITH ALL OF THE FACTOR OWNED BY ONE PERSON OR FAMILY.

* DENOTES A VALUE LESS THAN 0.5 PERCENT BUT DUE TO ROUNDING, PERCENTAGES MAY NOT ADD

ANNEX 7: EVALUATION STUDIES

TABLE A7.2

GOMBE A.D.P.: METHOD OF LAND PREPARATION FOR MAJOR CROPS (PERCENTAGE OF CROP AREA)

		NONE OR BY HAND	OXEN	TRACTOR
COTTON:	1977/78	70	27	3
	1978/79	85	15	0
	1979/80	9	90	2
	1980/81	26	73	1
COWPEA:	1977/78	68	32	0
	1978/79	74	26	0
	1979/80	18	82	0
	1980/81	19	81	0
GROUNDNUT:	1977/78	64	36	0
	1978/79	58	42	0
	1979/80	48	52	0
	1980/81	29	71	0
SORGHUM:	1977/78	79	21	0
	1978/79	56	44	0
	1979/80	37	63	0
	1980/81	37	63	*
MAIZE:	1977/78	49	51	0
	1978/79	64	36	0
	1979/80	16	84	0
	1980/81	9	86	4
MILLET:	1977/78	82	18	0
	1978/79	53	47	0
	1979/80	15	85	0
	1980/81	34	66	0.

NOTES: * DENOTES A POSITIVE VALUE UNDER 0.5. DUE TO ROUNDING PERCENTAGES MAY NOT SUM TO 100.

TABLE A7.3

GOMBE A.D.P.: AREA OF MAJOR CROPS BY NUMBER OF CROPS IN MIXTURE (% OF AREA)

		NUMBER OF CROPS IN MIXTURE			
		1	2	3	4+
COTTON:	1977/78	46	29	13	12
	1978/79	65	31	4	0
	1979/80	68	27	5	*
	1980/81	65	32	3	0
COWPEA:	1977/78	4	12	69	15
	1978/79	4	21	65	10
	1979/80	4	31	62	2
	1980/81	2	29	68	1
GROUNDNUT:	1977/78	14	13	55	18
	1978/79	19	36	31	13
	1979/80	24	35	34	6
	1980/81	24	53	22	1
SORGHUM:	1977/78	30	40	23	6
	1978/79	42	43	13	2
	1979/80	41	28	30	2
	1980/81	59	20	21	*
MAIZE:	1977/78	9	46	19	27
	1978/79	46	32	8	14
	1979/80	31	45	20	3
	1980/81	32	52	16	*
MILLET:	1977/78	7	60	25	8
	1978/79	11	62	24	4
	1979/80	8	41	49	2
	1980/81	15	39	45	1

NOTES: * DENOTES A POSITIVE VALUE UNDER 0.5 PER CENT.
DUE TO ROUNDING PERCENTAGES MAY NOT SUM EXACTLY TO 100.

TABLE A7.4

GOMBE A.D.P.: YIELDS AND AREAS FOR MAJOR CROPS BY TIMELINESS OF PLANTING

(KG./HA. AND % OF AREA)

CROP (TARGET DATE)		1977/78	1978/79	1979/80	1980/81
COTTON (19/6)					
CORRECT:	YIELD	326	835	582	681
	% AREA	2	5	16	5
LATE:	YIELD	431	508	410	536
	% AREA	98	95	84	95
MEDIAN PLANTING DATE		25/7	6/7	22/7	15/7
GROUNDNUT (12/6)					
CORRECT:	YIELD	1044	448	321	439
	% AREA	6	54	47	34
LATE:	YIELD	438	322	686	637
	% AREA	94	46	53	66
MEDIAN PLANTING DATE		17/7	11/6	12/6	27/5
SORGHUM (22/5)					
CORRECT:	YIELD	636	735	682	645
	% AREA	15	45	61	34
LATE:	YIELD	706	737	690	637
	% AREA	85	55	39	66
MEDIAN PLANTING DATE		7/6	23/5	17/5	27/5
MAIZE (12/6)					
CORRECT:	YIELD	764	597	802	1394
	% AREA	32	82	60	62
LATE:	YIELD	310	564	507	925
	% AREA	68	18	40	38
MEDIAN PLANTING DATE		5/7	6/6	6/6	5/6
MILLET (15/5)					
CORRECT:	YIELD	480	727	592	409
	% AREA	2	53	34	19
LATE:	YIELD	534	513	490	663
	% AREA	98	47	66	81
MEDIAN PLANTING DATE		2/6	14/5	21/5	23/5

NOTES:

FOR BASIS OF YIELD ESTIMATES, SEE ANNEX ON DATA QUALITY.

NO TARGET DATE FOR COWPEA, DUE TO WIDE VARIETY OF PLANTING STRATEGIES FOR THIS CROP.

TABLE A7.5

GOMBE A.D.P.: STAND DENSITY FOR MAJOR CROPS BY NUMBER OF CROPS IN MIXTURE (STANDS/HA.)

CROP	CROPS IN MIXTURE	1977/ 78	1978/ 79	1979/ 80	1980/ 81
COTTON:	1	16600	18900	15400	
<25000>	2	12200	12900	(14000)	
	3	13500	(13100)	(12200)	NA
	4	10700	-	(15800)	
	MEAN	13400	17200	15100	
COWPEA:	1	(13000)	(6300	13700	
<37000>	2	3800	4400	3800	
	3	3700	4100	4400	NA
	4	3200	(3600)	(3800)	
	MEAN	4000	4200	4600	
GROUNDNUT:	1	23300	21600	22000	
<55500>	2	19500	20000	18200	
	3	11800	2800	19900	NA
	4	6000	(26500)	(7900)	
	MEAN	13900	15400	19300	
SORGHUM:	1	15300	15100	13100	
<37000>	2	7800	7400	7000	
	3	4900	8500	5400	NA
	4	8200	(12400)	(7100)	
	MEAN	9400	11100	10400	
MAIZE:	1	(13900)	(14700)	11400	
<25000>	2	7500	10100	9700	
	3	(3600)	(5200)	(9900)	NA
	4	(5500)	(36200)	(9800)	
	MEAN	6700	15800	10500	
MILLET:	1	12800	16000	12300	
<18500>	2	7500	10100	12300	
	3	7200	9500	8000	NA
	4	6800	(13900)	(7000)	
	MEAN	7800	10700	8200	

NOTES: STANDCOUNTS ARE AGGREGATE MEANS (TOTAL STANDS FROM ALL PLOTS IN CLASS DIVIDED BY SUM OF PLOT AREAS FOR THAT CLASS).

FIGURES IN BRACKETS DERIVE FROM LESS THAN 10 PLOT OBSERVATIONS.

FIGURES IN ANGULAR BRACKETS <> ARE PROJECT RECOMMENDED DENSITIES.

TABLE A7.6

GOMBE A.D.P.: YIELDS AND AREAS FOR MAJOR CROPS WITH AND WITHOUT INORGANIC FERTILISER

(KG./HA. AND % OF AREA)

CROP		1977/78	1978/79	1979/80	1980/81
COTTON:					
WITH:	YIELD	305	465	416	392
	% AREA	22	50	36	27
WITHOUT:	YIELD	462	574	434	594
	% AREA	78	50	64	73
COWPEA:					
WITH:	YIELD	444	212	152	156
	% AREA	19	45	14	36
WITHOUT:	YIELD	77	152	142	219
	% AREA	81	55	86	64
GROUNDNUT:					
WITH:	YIELD	631	194	128	321
	% AREA	11	46	7	34
WITHOUT:	YIELD	402	555	542	349
	% AREA	89	54	93	66
SORGHUM:					
WITH:	YIELD	618	713	766	536
	% AREA	10	23	15	16
WITHOUT:	YIELD	688	700	671	671
	% AREA	90	77	85	84
MAIZE:					
WITH:	YIELD	740	560	896	1414
	% AREA	25	38	28	52
WITHOUT:	YIELD	326	609	599	869
	% AREA	75	62	72	48
MILLET:					
WITH:	YIELD	415	476	477	799
	% AREA	11	31	15	20
WITHOUT:	YIELD	534	693	549	572
	% AREA	89	69	85	80

NOTES: YIELDS ARE AGGREGATE MEANS (TOTAL PRODUCTION FROM ALL PLOTS IN CLASS DIVIDED BY SUM OF PLOT AREAS FOR THAT CLASS). 1976/77 DATA CONTAIN A PROPORTION OF SPURIOUS ZERO YIELDS AND THUS UNDERESTIMATE TRUE YIELDS. ALL YIELDS WERE ORIGINALLY ESTIMATED BY THE BUNDLE METHOD BUT HAVE BEEN CONVERTED TO THEIR EQUIVALENTS UNDER THE MORE RECENT TRIANGLE METHOD.

ANNEX 7: EVALUATION STUDIES

TABLE A7.7

GOMBE A.D.P.: ADOPTION OF INORGANIC FERTILISER BY FARM SIZE (% OF FARMERS USING)

FARM SIZE RANGE (HA.)	1978/79	1980/81
0.0-0.9	33	27
1.0-1.9	27	26
2.0-2.9	15	34
3.0-3.9	11	57
4.0-4.9	13	58
5.0-5.9	43	67
6.0-6.9	67	83
7.0+ 2/	25	75
ALL FARMS	21	42

NOTES: 2/ FARMS OF 7.0 HA. AND OVER GROUPED TOGETHER BECAUSE CASE NUMBERS IN INDIVIDUAL SIZE INTERVALS ARE SMALL.

TABLE A7.8

GOMBE A.D.P.: YIELDS OF MAJOR CROPS BY NUMBER OF CROPS IN MIXTURE (KG./HA.) 1/

	CROPS IN MIXTURE	1977/78	1978/79	1979/80	1980/81
COTTON:	1	441	594	432	651
	2	387	353	407	400
	3	347	(635)	(388)	(95)
	4	631	-	(894)	-
MEAN (ALL MIXTURES)		428	519	426	546
COWPEA:	1	(161)	(284)	(185)	(167)
	2	92	305	110	167
	3	66	141	157	167
	4	60	(116)	(194)	-
MEAN (ALL MIXTURES)		71	179	144	167
GROUNDNUT:	1	686	597	186 2/	411
	2	404	549	380	334
	3	447	179	236	(214)
	4	194	(144)	(153)	-
MEAN (ALL MIXTURES)		427	391	248	325
SORGHUM:	1	656	940	806	759
	2	657	503	608	402
	3	783	677	603	482
	4	790	(292)	(531)	-
MEAN (ALL MIXTURES)		677	719	684	625
MAIZE:	1	(1000)	731	667	1210
	2	448	649	544	1361
	3	(254)	(371)	1033	1279
	4	(360)	(121)	(531)	-
MEAN (ALL MIXTURES)		430	591	676	1300
MILLET:	1	1113	699	880	839
	2	484	671	563	564
	3	484	518	467	601
	4	428	(357)	(368)	-
MEAN (ALL MIXTURES)		475	627	538	625

NOTES:

1/ FOR METHODS OF YIELD ESTIMATION AND BASIS OF YIELD CALCULATIONS, SEE ANNEX ON DATA QUALITY.

2/ ESTIMATE BASED ON BUNDLE SUBSAMPLE ONLY.

3/ BRACKETED ESTIMATES DERIVE FROM UNDER 10 PLOT CASES.

TABLE A7.9 1/ 2/ 3/

GOMBE A.D.P.: HOUSEHOLD AREA, PRODUCTION AND PARTICIPATION FOR MAJOR CROPS (HA., KG. & % GROWING)

		1977/78	1978/79	1979/80	1980/81
COTTON:	AREA	0.68	0.44	0.30	0.57
	PROD'N.	291	227	126	310
	%	52	43	21	40
COWPEA:	AREA	0.53	0.28	1.19	0.61
	PROD'N.	38	50	172	102
	%	44	39	51	39
GROUNDNUT:	AREA	0.30	0.39	0.35	0.15
	PROD'N.	130	152	86	49
	%	27	38	30	22
SORGHUM:	AREA	2.34	2.37	2.30	1.71
	PROD'N.	1582	1702	1570	1070
	%	95	98	97	89
MAIZE:	AREA	0.26	0.18	0.35	0.61
	PROD'N.	111	109	234	793
	%	33	39	31	48
MILLET:	AREA	1.45	1.30	1.23	0.75
	PROD'N.	690	815	664	468
	%	83	79	70	65
MEAN FARM SIZE(HA)		2.97	3.13	3.29	3.45

NOTES:

1/ 1977/78 AND 1980/81 FARM SIZES FROM EVALUATION STUDIES. 1978/79 AND 1979/80 INTERPOLATED, AND CROP AREAS ADJUSTED ACCORDINGLY. MEANS ARE CALCULATED OVER ALL HOUSEHOLDS, NOT ONLY THOSE GROWING THE CROP.

2/ FOR DERIVATION OF YIELD ESTIMATES USED TO FORM PRODUCTION ESTIMATES, SEE ANNEX ON DATA QUALITY. ALL PRODUCTION ESTIMATES RELATE TO ADJUSTED FARM SIZES.

3/ PERCENTAGES PARTICIPATING ARE FROM UNWEIGHTED DATA.

ANNEX 7: EVALUATION STUDIES

TABLE A7.10

GOMBE A.D.P.: CONSUMPTION OF OWN PRODUCTION FOR MAJOR CROPS

CROP	ENERGY VALUE (KCAL/KG.)	1977/78 KG./ HEAD/ YEAR	1977/78 KCAL/ HEAD/ DAY	1978/79 KG./ HEAD/ YEAR	1978/79 KCAL/ HEAD/ DAY
COWPEA	3380	13.3	123	6.3	58
GROUNDNUT	5490	.4	6	.3	5
SORGHUM	3430	155.9	1465	182.2	1712
MAIZE	3680	24.4	246	44.7	451
MILLET	3870	90.7	962	107.5	1140
PEPPERS	3460	1.4	13	NA	NA
RICE	3640	1.6	16	1	10
TOTAL KILOCALORIES/HEAD/DAY			2831		3375
HOUSEHOLD SIZE			6.20		6.20 2/

NOTES: 1/ ENERGY VALUES FROM E.B. SIMMONS, "CALORIE AND PROTEIN INTAKES IN THREE VILLAGES OF ZARIA PROVINCE, MAY 1970 -JULY 1971", SAMARU MISCELLANEOUS PAPER NO. 56.

2/ ESTIMATED; SURVEY DATA NOT AVAILABLE.

TABLE A7.11

GOMBE A.D.P.: HOUSEHOLD INCOME AND EXPENDITURE

(NAIRA)

	1977/78	1978/79 1/	1979/80
A. INCOME			
1. VALUE OF FARM CROP OUTPUT	514.11	695.86	523.98
2. VALUE OF LIVESTOCK OUTPUT	85.72	112.83	114.43
3. VALUE OF NON-FARM OUTPUT	29.42	37.40	NA
4. INCOME FROM NON-FARM ACTIVITIES	441.50	313.90	394.50
5. BORROWINGS	12.13	13.12	NA
6. OTHER INCOME 2/	67.91	37.66	153.78
TOTAL	1150.79	1210.77	1186.69
B. OUTGOINGS			
1. CROP EXPENDITURE: HIRED LABOUR	60.29	97.07	)46.91
OTHER	9.69	5.20	)
2. EXPENDITURE ON LIVESTOCK	3.21	9.31	1.43
3. EXPENDITURE ON NON-FARM ACTIVITIES	295.01	189.38	252.22
4. LENDINGS & LOAN REPAYMENTS	18.22	14.76	NA
TOTAL	386.42	315.72	300.56
NET INCOME (A-B)	764.37	895.05	886.13
C. HOUSEHOLD EXPENDITURE			
11. VALUE OF OWN CROPS CONSUMED	387.20	533.44	412.38
12. VALUE OF LIVESTOCK PRODUCTS CONSUMED	2.14	3.25	NA
13. VALUE OF OFF-FARM PRODUCTION CONSSUMED	29.42	37.40	NA
14. HOUSEHOLD CASH EXPENDITURES:			
UNPROCESSED FOOD	174.35	147.16	)
PROCESSED & PREPARED FOOD	143.24	144.08	)450.39
HOUSEHOLD & PERSONAL ITEMS	118.72	140.39	)
OTHER ITEMS	5.40	3.87	64.97
TOTAL	860.47	1009.59	927.74
SURPLUS (DEFICIT)(A-B-C)	(96.10)	(114.54)	(41.61)

NOTES: 1/ DATA ADJUSTED TO ALLOW FOR MISSING DATA IN 5 WEEKS OF THE YEAR.

2/ INCLUDING UNSPECIFIED

ANNEX 7: EVALUATION STUDIES

TABLE A7.12

GOMBE A.D.P.: DISTRIBUTION OF FARM NET INCOME

1/ NET INCOME (NAIRA)	1977/78	1978/79
0- 250	39	20
251- 500	31	24
501- 750	18	24
751-1000	5	18
1001-1250	4	3
1251-1500	3	6
OVER 1500	0	6

NOTES: 1/ SUM OF FARM RECEIPTS IN KIND, CROP SALES, VALUE OF OWN PRODUCTION CONSUMED, LESS FARM VARIABLE COSTS.

2/ DUE TO ROUNDING, PERCENTAGES DO NOT NECESSARILY SUM TO 100.

TABLE A7.13

GOMBE A.D.P.: PRODUCER PRICE FOR MAJOR CROPS [1/]

(NAIRA PER TONNE)

	1976	1977	1978	1979	1980 [2/]
COCOYAM	NA	211	(289)	372	524
COWPEA	(256)	(395)	643	482	396
COTTON [3/]	300	300	300	300	350
GROUNDNUT [4/]	(170)	(320)	668	(428)	426
MAIZE	NA	226	244	246	233
MILLET	(183)	(222)	240	236	233
PEPPERS	NA	(300)	934	1132	2267
RICE [5/]	(541)	(547)	(761)	(644)	377
SORGHUM	(209)	265	272	234	163
SWEET POTATO	NA	195	321	(395)	502

NOTES: 1/ FIGURES IN BRACKETS ARE MARKET PRICES AND HAVE BEEN USED WHERE PRODUCER PRICES WERE UNOBTAINABLE OR BELIEVED TO BE UNRELIABLE.

2/ JANUARY TO NOVEMBER

3/ ALL COTTON PRICE DATA ARE CONSIDERED UNRELIABLE. THE N300 PRICE REFLECTS A 10 PER CENT DISCOUNT ON THE NOMINAL MAINTAINED PRICE.

4/ IN SHELL.

5/ PADDY (THRESHED BUT NOT HUSKED).

TABLE A7.14

GOMBE A.D.P.: PRICE INDICES

	1977	1978	1979	1980
PRODUCER PRICES:	100	113	98	98
CONSUMER PRICES:	100	112	126	NA

TABLE A7.15

GOMBE A.D.P.: AGRICULTURAL KNOWLEDGE OF FARMERS AND EXTENSION AGENTS

A. PERCENTAGE MENTIONING PRACTICES RECOMMENDED FOR INCREASING YIELDS

	FARMERS		AGENTS	
	1978	1980	1978	1980
EARLY LAND PREPARATION.	76	67	81	73
EARLY PLANTING	89	64	81	73
IMPROVED/GOOD SEED	53	37	30	51
SEED DRESSING	40	40	41	63
CORRECT PLANT POPULATION.	20	9	67	48
PROMPT WEEDING	73	78	85	80
FERTILISER	74	66	94	91
CROP ROTATION	19	5	7	26
PEST/DISEASE CONTROL.	14	4	51	59
MEAN NO. MENTIONED	4.5	3.7	5.3	5.8

B. PERCENTAGE UNDERSTANDING GENERAL CONTRIBUTION TO PLANT GROWTH OF INORGANIC FERTILISERS.

	FARMERS		AGENTS	
	1978	1980	1978	1980
SUPERPHOSPHATE	54	60	100	98
NITROGENOUS FERTILISERS	56	58	98	98
COMPOUND FERTILISERS	*	45	*	95

C. PERCENTAGE KNOWING RECOMMENDED FERTILISER APPLICATION RATES FOR MAJOR CROPS.

	FARMERS		AGENTS	
	1978	1980	1978	1980
MAIZE	[illegible]	[illegible]	[illegible]	[illegible]
SORGHUM	0	4	68	57
GROUNDNUTS	0	2	52	56
COTTON	0	1	NA	47

ANNEX 7: EVALUATION STUDIES

TABLE A7.16

GOMBE A.D.P.: PARTICIPATION IN PROJECT ACTIVITIES

(PERCENTAGE OF FARMERS)

	1977	1979
VISITED FARM SERVICE CENTRE:		
FOR ADVICE	11	12
TO MAKE PURCHASE	95	70
PERSONAL EXTENSION VISIT	17	9
VISITED DEMONSTRATION PLOT	25	12
MEMBER OF PROJECT GROUP	14	12
ATTENDED PROJECT FILM SHOW	0	74
LISTENED TO PROJECT RADIO	47	57

TABLE A7.17

FUNTUA A.D.P.: SORGHUM ENTERPRISE GROSS MARGINS PER HECTARE

(CURRENT NAIRA, 1977/78)

	SOLE SORGHUM	SORGHUM/ MILLET	SORGHUM/ G'NUT
GROSS VALUE OF OUTPUT	79	110	120
LESS: HIRED LABOUR	29	20	33
LESS: OTHER COSTS	7	11	14
MARGIN PER HECTARE	43	79	73
TOTAL LABOUR (HOURS)	521	789	837
MARGIN PER HOUR	0.08	0.10	0.09

TABLE A7.18

GUSAU A.D.P.: COTTON ENTERPRISE GROSS MARGINS PER HECTARE

(CURRENT NAIRA, 1977/78)

	SOLE COTTON	COTTON/ MILLET	COTTON/ MILLET/ COWPEA
GROSS VALUE OF OUTPUT	92	140	191
LESS: HIRED LABOUR	28	16	24
LESS: OTHER COSTS	4	8	9
MARGIN PER HECTARE	60	116	158
TOTAL LABOUR (HOURS)	457	806	933
MARGIN PER HOUR	0.13	0.14	0.17

TABLE A7.19

GOMBE A.D.P.: MAIZE ENTERPRISE GROSS MARGINS PER HECTARE

(CURRENT NAIRA, 1977/78)

	SOLE MAIZE	MAIZE/ COTTON	MAIZE/ SORGHUM
GROSS VALUE OF OUTPUT	109	131	217
LESS: HIRED LABOUR	19	33	34
LESS: OTHER COSTS	7	17	17
MARGIN PER HECTARE	83	81	166
TOTAL LABOUR (HOURS)	746	497	719
MARGIN PER HOUR	0.11	0.16	0.23

ANNEX 8 : DATA QUALITY

A8.1 General

The evaluation data gathered on Gombe A.D.P. and which form the basis for much of this report, are characterised by a number of problems which have had to be resolved in the course of data processing and analysis. Some of these problems are common to all the first-generation A.D.P.s, while others relate to Gombe alone.

A8.2 Sample Design Problems

Prior to 1980/81 the sample designs used for evaluation studies were not self-weighting, with the result that small village wards exerted an influence on whole-Project estimates greater than their share of population justified. In addition, the 1979/80 sample was stratified by Project contact and ox-ownership, the sampling proportions for the strata being held at different levels to ensure adequate sample sizes from the smaller strata for purposes of inter-stratum comparison. This is a legitimate practice, but if data from such a sample are to be used for whole-Project estimates, the relative proportions of the strata must be corrected back to those existing in the population.

A8.3 The biases resulting from these sample design features have been removed by applying weights (correction factors) to the data from each sample ward. For 1979/80, the weights are applied to each

stratum within each ward. The weight for, say, ward X is

$$W = \frac{A}{B} \times \frac{C}{D}$$

where: A = total households in ward X

B = sample households in ward X

C = total households in sample

D = total householdsin all sample wards.

and the weight for, say, stratum Y in ward X is:

$$W = \frac{E}{F} \times \frac{G}{H}$$

where E = total households in stratum Y in ward X

F = sample households in stratum Y in ward X

G = total households in sample

H = total households in all sample wards

A8.4 Yield Estimates

Yield estimates for all evaluation surveys up to 1979/80 were made by the "bundle" method. This consists of counting the number of bundles, baskets or other traditional harvest units removed from the plot, and multiplying this number by an average bundle weight estimated from a subsample of the units from that same plot. This is in theory an accurate technique, but in practice there are a number of points at which errors can be introduced. It was therefore replaced by harvesting and weighing the production of a

sample triangle laid in the plot, the "triangle" method. The change began at Gombe in 1979/80, the sample for that year bei divided equally between bundle and triangle methods in an attempt to gauge their comparability. Unfortunately bundle and triangle methods were not applied to the same plots, or even households which would have enhanced the value of the comparison. From 1980/81, all yield estimation, at Gombe and elsewhere, has been wholly by the triangle method.

8.5 Both at Gombe and elsewhere, the change in estimation method coincides with a sharp increase in the resulting yield estimates for all crops. There were no agronomic, economic or climatic factors likely to have caused a general increase of this kind, and it is therefore considered to be an artefact generated by the change of method. Since the divergence between bundle and triangle data series is too great for them to be used together without adjustment, it has been necessary to develop a method of estimating a correction factor from one to the other.

8.6 The method adopted has been to estimate the difference due to the change of methods from the movement of the yield estimates for a crop which would otherwise be expected to show a stable yield level, or at least a stable trend. Such a crop is likely to be a traditional subsistence staple, which will always be planted in a timely manner, which will receive consistently high degree of care and attention, which will be little affected by year-to-year changes in prices and resource levels, and which is likely to be only slowly affected by innovations. For Gombe, as for much of

northern Nigeria, sorghum fits this specification well.

A8.7 At Gombe sorghum was, in the period covered by this report, scarcely affected by innovation and the bundle yield level was very stable. The change due to estimation method has therefore been estimated by pooling the yield estimates for the three bundle method years (1977/78, 1978/79, and the bundle subsample for 1979/89) and comparing this estimate with the pooled yield estimate for the two triangle method years (1980/81, and the triangle subsample for 1979/80). For conversion from bundle to triangle this yields a factor of 683.6/430.3, or 1.588.

A8.8 The triangle method is considered to be inherently more reliable under field conditions, although APMEPU studies on it suggest that it gives overestimates of some 10 per cent compared with true yield levels (allowed for in deriving the conversion factor above). Additionally, it is necessary to note that data are still being generated by evaluation studies and that all new yield estimates are by the triangle method. For ease of maintaining a comparable data series, therefore, the triangle estimate should be the standard if no contervailing factor is known. For these reasons all bundle yield estimates for the years covered by this report have been converted to triangle equivalents, those for 1979/80 being pooled with the triangle estimates for the same year.

A8.9 Data Cleaning

Raw sample survey data on crop yields commonly contain a proportion of grossly distorting outlying observations caused by errors,

ommissions and falsifications during data gathering and pro-
cessing. During the period covered by this report the Agric
including Gombe, had few facilities for data analysis, or
effective validation, so that by the time such anomalies were
discovered the survey year was usually over, and the apportunity
to ascertain causes and perform a soundly based correction, had
been lost. The decision was therefore ultimately taken to exclu-
all yield observations above a threshold level, that level bei
set after consideration of the shape of the yield distributio
and the available independent evidence on likely yield level
under prevailing conditions and management levels. For Gombe
the years covered by this report the thresholdd was set at 2500
per hectare for all crops (bundle estimate, see above). This
be high enough to include some invalid outliers for lower-yieldi
crops, such as cowpea, but it excludes the most damaging outlie
and coincides well with the upper end of the continuous y
distributions of most of the higher-yielding crops.

A8.10 Farm Sizes and Crop Areas

As the series below shows, the mean farm size estimates given
evaluation surveys at Gombe fluctuate widely. There is no

Year	1977/78	1978/79	1979/80	1980/81
Ha.	2.97	5.05	2.34	3.45

independent evidence to suggest genunine variation of the ma
nitude shown, and the presumption must be that either inconsis-
tent sampling practices, or the drawing of aberrant samples due t

the use of small sample sizes (as in 1978/79), is responsible. Chi-squared tests were run on the farm size distributions for all pairs of years with the results shown below:

Chi-squared values (10 d.f.)

	1977/78	1978/79	1979/80
1978/79	50.95***		
1979/80	24.15***	63.05***	
1980/81	11.17 N.S.	47.16***	26.11***

N.S. = difference of distributions not significant at $P = 0.950$

*** = difference of distributions significant at $P \geq 0.999$

Only for 1977/78 and 1980/81 are there reasonable grounds for supposing that the distributions represent the same populations. These are fortunately the end members of the series, so that it is legitimate to generalise from them to the intervening years. Although the shapes of the 1977/78 and 1980/81 distributions do not differ significantly, the difference of their means is significant at the 99 per cent level of probability. Mean farm sizes for the two intervening years have therefore been estimated by linear interpolation between the end years. Crop area estimates have been adjusted accordingly, but this does not, of course, remove any biases which may have been introduced in factors correlated with farm size. The data should therefore still be treated with caution where such factors are involved.

A8.11 Calculation of Means

All yield and stand density estimates issued by APMEPU prior to July 1981 were plot case means. For a yield estimate this is calculated as

$$Y = {}^{1}/_{n} (P_1/A_1 + P_2/A_2 + \ldots + P_n/A_n)$$

where: $A_1, A_2 \ldots A_n$ = Area of plots 1, 2 ... n

$P_1, P_2 \ldots P_n$ = Production from plots 1, 2 ... n

n = number of plots

This gives equal weight to all plots regardless of size, and produces a whole-Project yield estimate which is biased upwards because small plots tend to have high yields but form only a small proportion of total area.

A8.12 For plot-based analyses like the majority of the tabulations in Section 7 of this report, the plot case mean has been replaced by the ratio mean derived from aggregated values; this, when applied to yields, is termed the yield rate. It is calculated as

$$Y = (P_1 + P_2 + \ldots + P_n) / (A_1 + A_2 + \ldots + A_n)$$

with the variables defined as before. All yields and stand densities in this report are calculated on this basis.